MACHINERY

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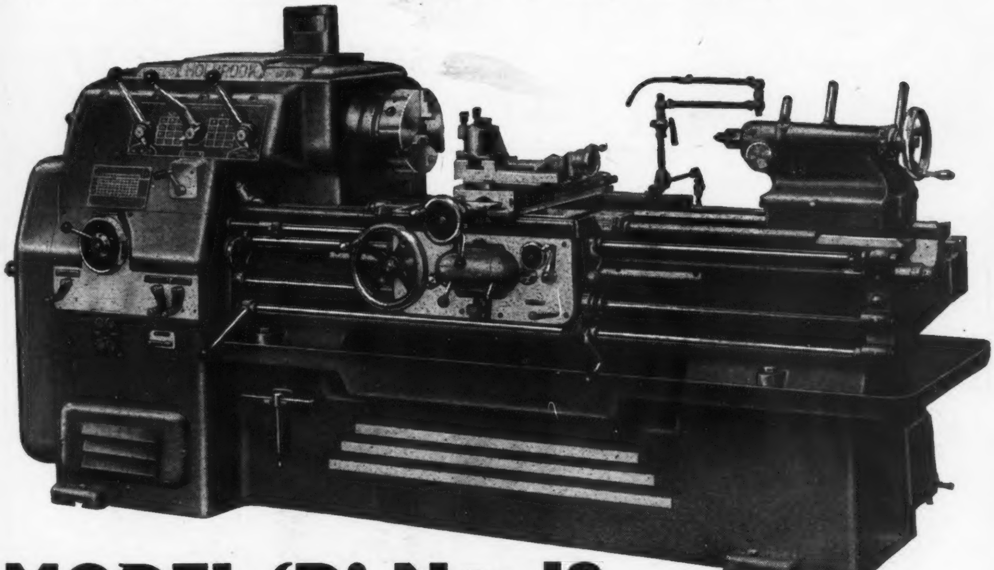

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V10B

Talk to Sykes about the V10B . . .

for racks and segment gears

The V10B Rack cutting model cuts spur or helical racks, up to 24 in. long, in a pre-set Auto-cycle of 1, 2 or 3 cuts. Once set the machine requires no further attention other than loading of the workpiece. On removal of the rack cutting sub-table the machine reverts to a conventional gear shaper but with the additional facility of cutting segment gears, of any desired angle, in an automatic cycle of one to three cuts. Infinitely variable speeds and feeds. Built-in calculator dials. Switch selected direction of feed. Adjustable rotation controller for segment gear cutting. Auto table reverse. Electro-magnetic feed clutches. Constant hydraulic infeed with micrometer setting. Direct reading saddle indicator. PLUS . . . The availability of the basic V10B range of equipment and accessories.

If you have racks or segment gears on your production programme, write for a copy of brochure P18/60.

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and associated companies:

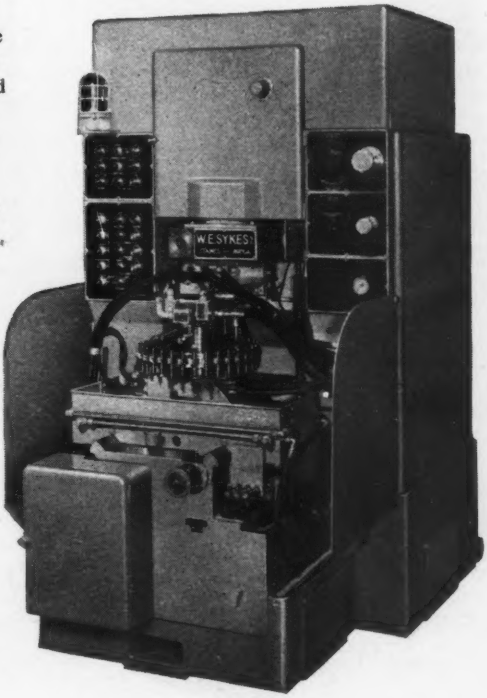
Sykes Tool Corporation Ltd., Windsor, Ontario, Canada. Sykes Machine & Gear Corporation, Detroit, Michigan, U.S.A. W. E. Sykes Ltd., Mascot, Sydney, NSW, Australia.

Talk to Sykes about the V10 B-Sykomatic . . .

V10B

for large volume or mass production

V10B-Sykomatic Gear Generators incorporate the well-proven Sykomatic principle of rotary magazine loading for simple work holding and high speed indexing. Models for Internal or External gears are available and, for suitable external components, hopper feed can be supplied. Interchangeable turret plates and tooling can be supplied for the cutting of two or more components on the same machine. Electro-hydraulic fully automatic cycle. All motions individually controlled during setting. Sizing switch for rapid setting after cutter change. Foolproof interlocked cycle with adequate safety devices and simple work loading. Automatic magnetic swarf extractor as optional extra. Fully automatic and interlocked 'cutter lift' for Internal gear components. PLUS . . . the additional advantage that over 90% of all components and machine parts are common to each of the other models in the V10B range.



If you would like to know more about the advantages of the V10B-Sykomatic range, write for a copy of brochure P18/60.

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Talk to Sykes about the VIOB . . .

for medium batch production

V10B Vertical Gear Generators are available in Semi-Automatic models for the medium or large batch production of Internal or External gears. A pre-set cycle and interlocked hydraulic work clamping relieves the operator of all attention except for component loading. Automatic cutter 'lift' or 'stop at top of stroke' allows simple foolproof loading of Internal gears and permits optimum cutting speeds to be used.
Infinitely variable speeds and feeds. Switch selected 1, 2 or 3 cut hydraulic Infeed. Autocycle, including rapid saddle traverse and adjustable drop-off point. Visual indication of progress of cycle. Sizing control switch for rapid checking after cutter change. Constant, pre-set, hydraulic Infeed, independent of component diameter. Adjustable off-set saddle for maximum feed rates. PLUS . . . Automation; by coupling into conveyor type system. Alternatively a number of machines can be linked into a continuous production line.

If you would like to know more about the unique features of the V10B Semi-Auto models, write for a copy of brochure P18/60.

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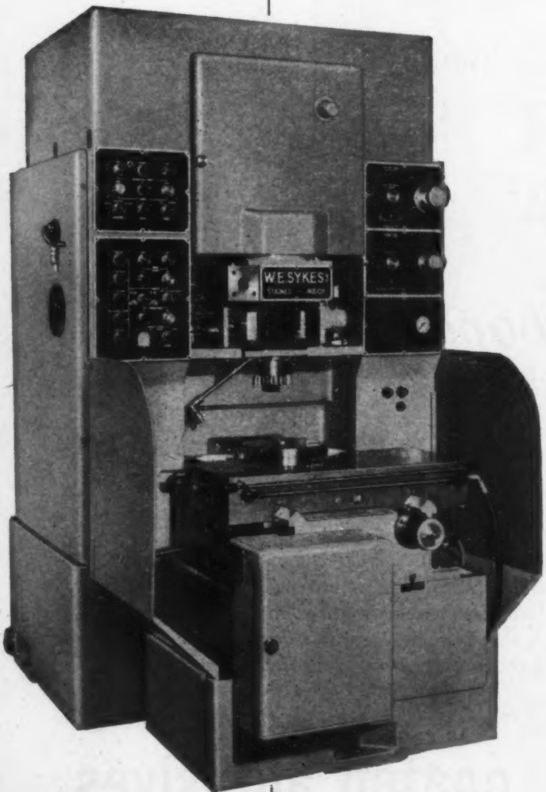
V10 B

Talk to Sykes about the V10 B . . .

for jobbing or small batch production



The basic model V10B Vertical Gear Generator; the most practical approach to the problem of low cost, small batch, gear production. Not only reduces cutting times by up to 50% but increases machine utilisation by its exceptional simplicity of setting, operating and maintenance.

Robust construction with increased pitch capacity. Infinitely variable speeds and feeds. Hydraulic Infeed with switch selected 1, 2 or 3 cuts. Faster infeed; no cams to adjust. Rapid saddle traverse with adjustable drop-off. Adjustable off-set saddle for maximum feed rates. Setting time cut by one third. Ample reserve of hydraulic power for work clamping. Foolproof operation. PLUS . . . An extensive range of optional equipment and accessories.

If you would like to know more about the V10B for jobbing or small batch production, write for a copy of brochure P18/60.

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SLIDING HEAD AUTOMATIC

Work is supported close to the radial tools ensuring maximum accuracy on long slender parts. Second operations eliminated, both ends being completed at the one operation. Radial tools provided with micrometer setting. Sturdy built-in 3-spindle drilling and tapping slide gives maximum threading capacity. Camshaft readily accessible for setting. Wide range of camshaft speeds provided and accelerator reduces idle time.

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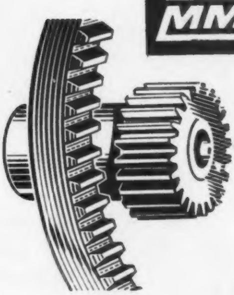

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REDIN GEAR DEBURRING MACHINES

MODEL 36

MODEL 20

MODEL 20		MODEL 36	
Capacity (External)		Capacity (External)	
Maximum Pitch Diameter	20"	Maximum Pitch Diameter	36"
Maximum Gear Face ...	6"	Maximum Gear Face ...	12"

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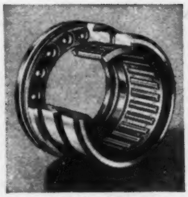
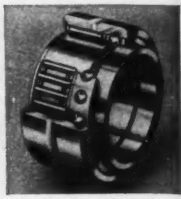
Ina Needle Bearing


Ina Combined Bearing (NKX Series)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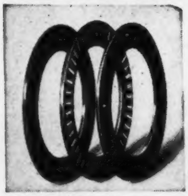
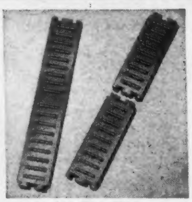

Ina Thrust Bearing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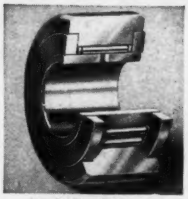
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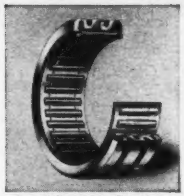
Ina Cam Follower

introduce new principles into engineering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Milling Heads Traverse : Select Direction and whether Rapid Feed or Inch 5
Milling Head : Unclamp & Start or Stop & Clamp 6
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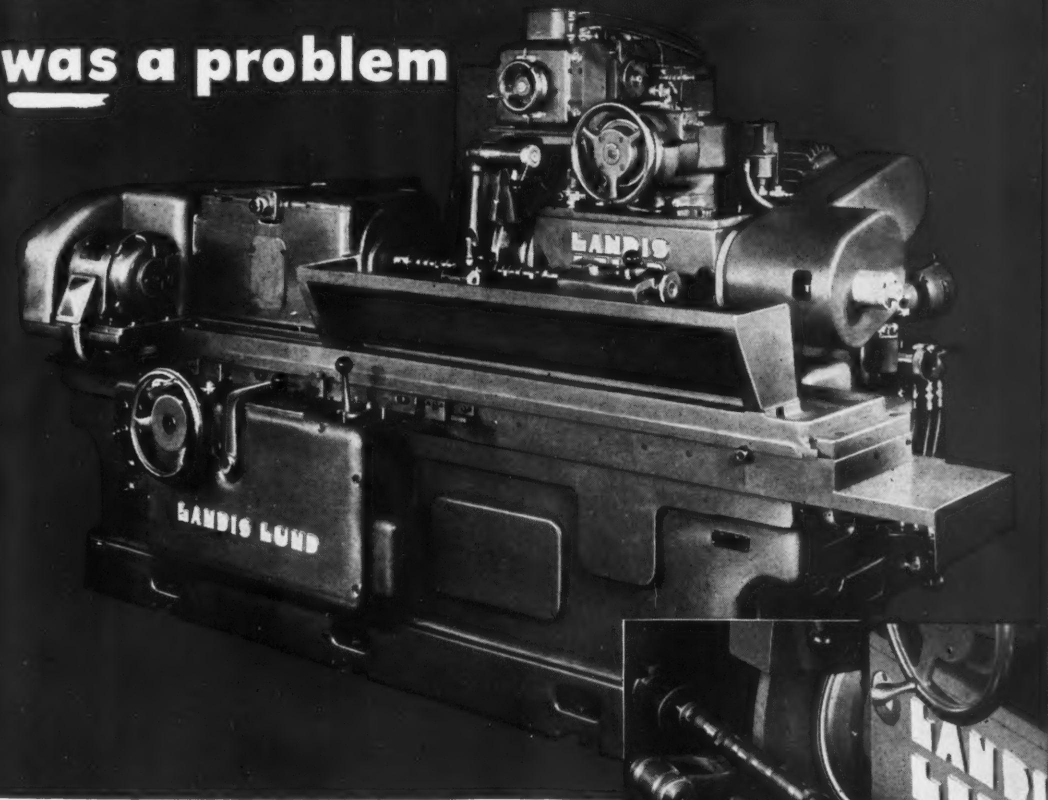

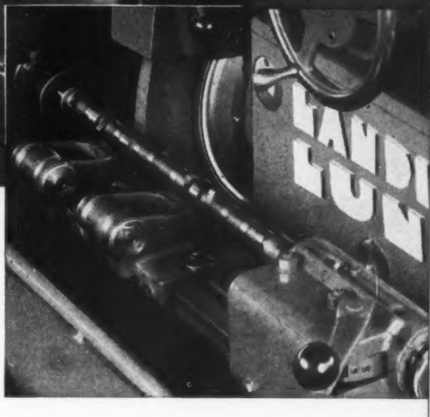

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Tailored to the job of camshaft grinding — that's the Landis-Lund type DH machine.

The principles used in this machine have proved themselves over long periods in leading automobile plants throughout the world.

Available with 26", 30" or 40" cradles. Up to 0.200" stock may be removed. Tapered contours, in one direction, or both can be ground on a production basis.

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Grinding 13 Contours on Camshafts for 6 cylinder engines, removing .010" stock, production is 12 Camshafts per hour, one man operating 4 machines.

LANDIS LUND 5" x 40" TYPE DH CAM GRINDER

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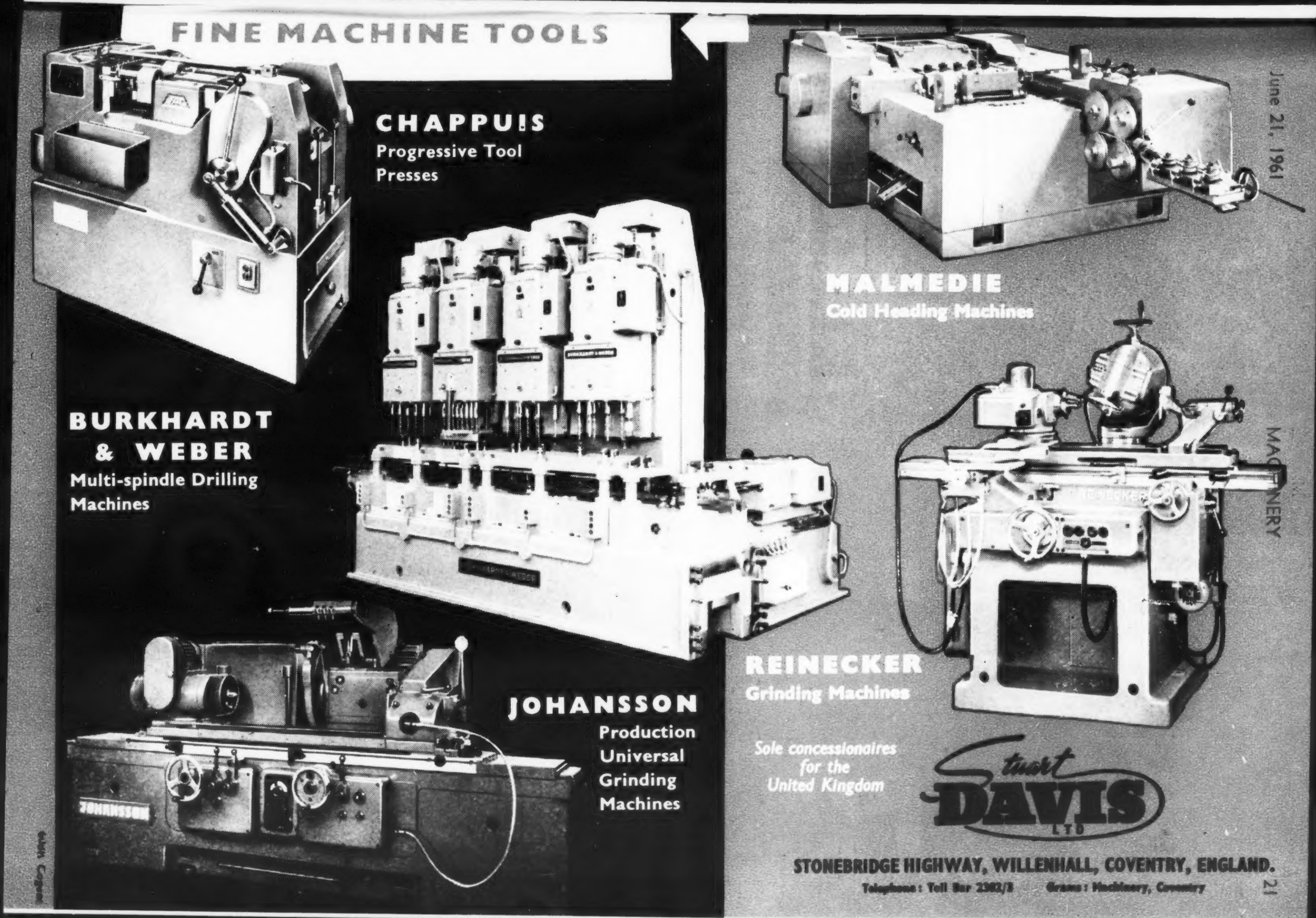
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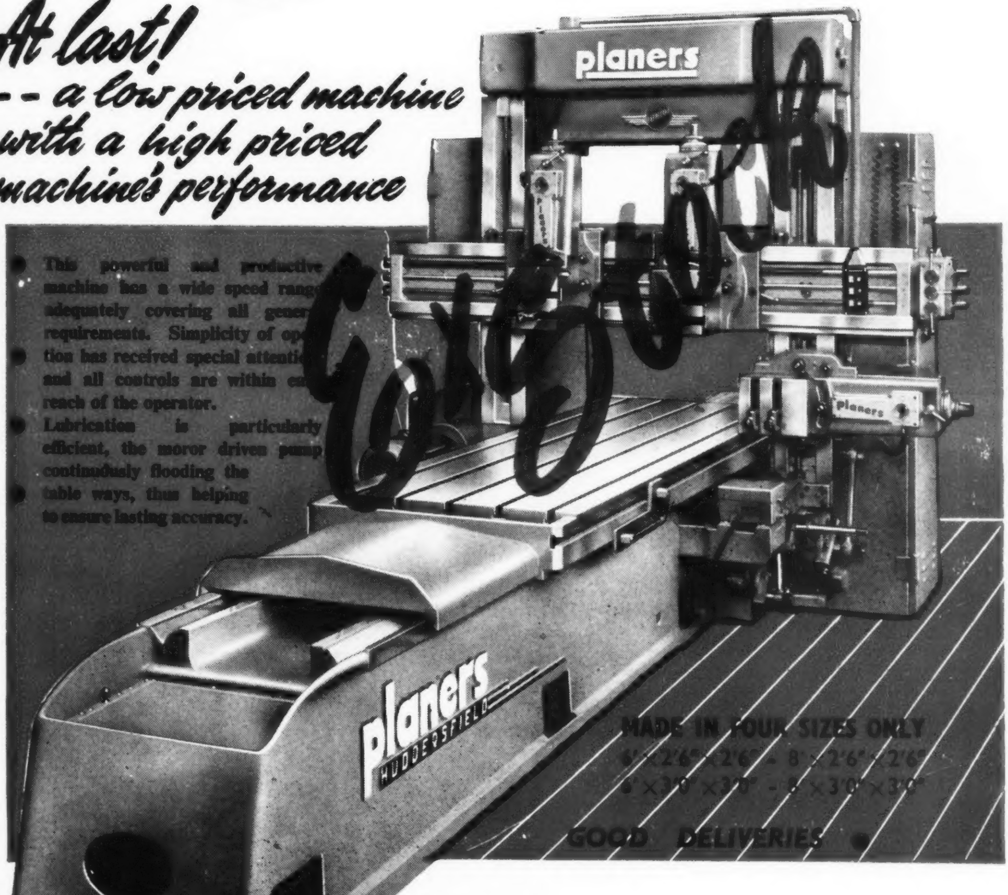

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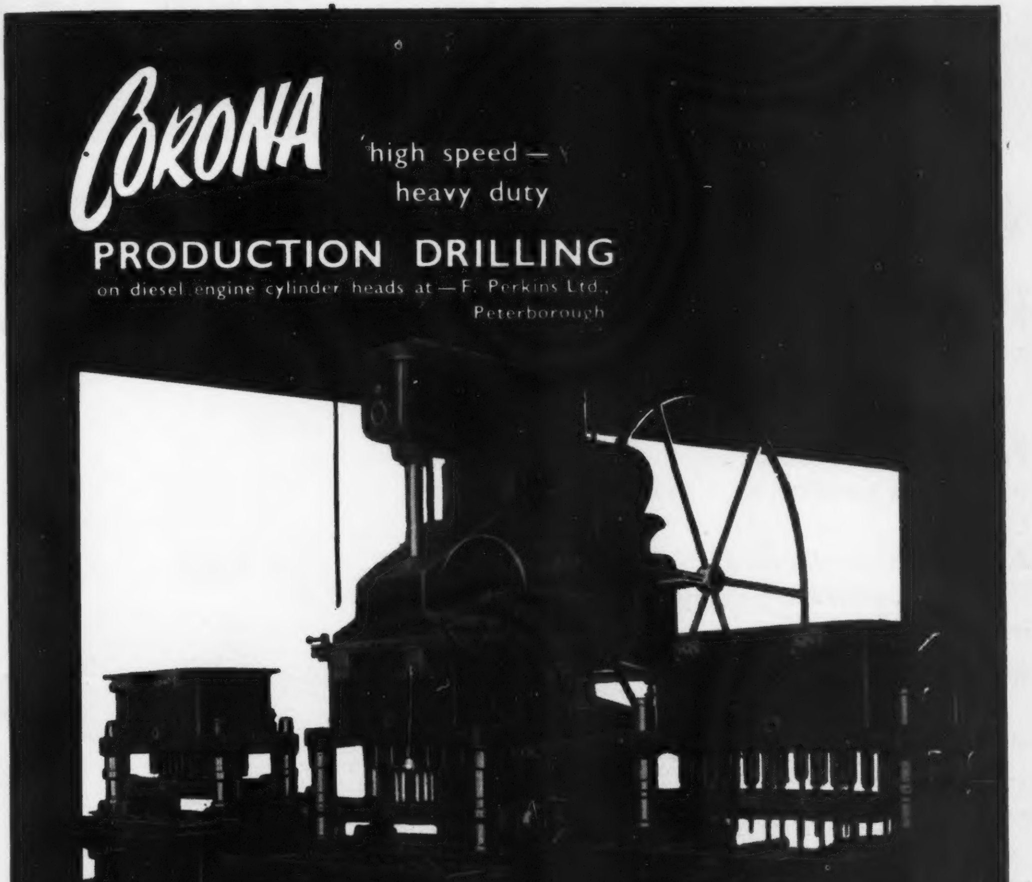
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high speed —
heavy duty
PRODUCTION DRILLING
on diesel engine cylinder heads at — F. Perkins Ltd., Peterborough
This Model 31A heavy duty Production drilling machine has three sets of interchangeable 30-spindle fixed centre multi-heads and fixtures for drilling three sizes of Diesel engine cylinder heads.
Eight similar sets are in operation at F. Perkins Ltd., Peterborough. Outstanding amongst the many features of this equipment is great stability, and accuracy of re-location with quick changeovers.
Complete changeover in nine minutes.
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1-18 PLAIN AUTOMATIC MILLING MACHINE

Full Automatic table cycles.
Automatic backlash eliminator to table.
Automatic spindle stop.
Dynapoise (vibration damping) overarm.

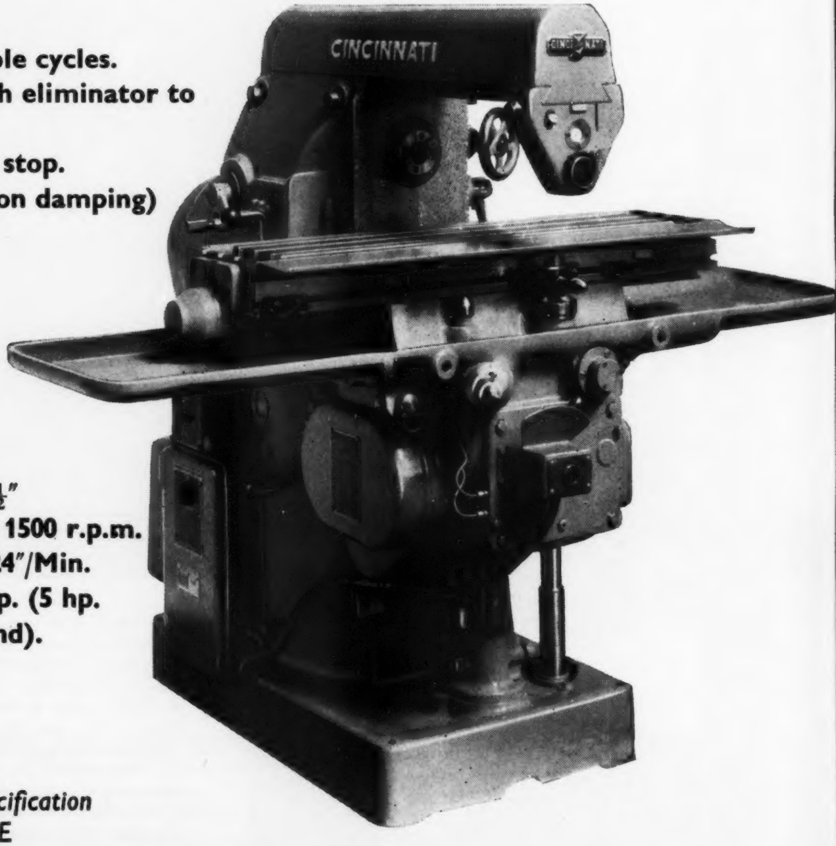

Table size 10" × $35\frac{1}{2}$"
Speed range — 50 - 1500 r.p.m.
Feed range — $\frac{1}{2}$" - 24"/Min.
Drive motor — 3 hp. (5 hp. available on demand).

Write now for full specification Catalogue No. M-1555E

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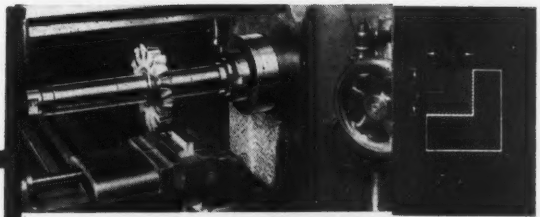
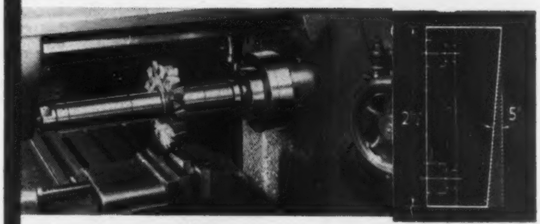
—simple tooling using a standard machine vice for a typical short-run job in cold rolled mild steel in our own works.



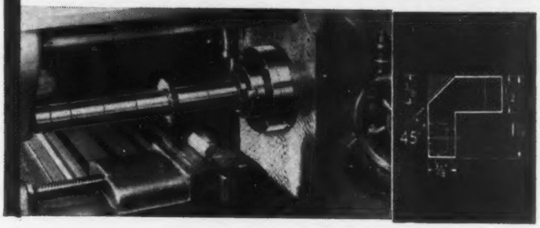
Operation 1

Mill step.
Set-up ... 16 mins.
Milling (24 pieces) 39 mins.
Total 55 mins.



Operation 2

Mill 5° angle.
Set-up ... 4 mins.
Milling (24 pieces) 39 mins.
Total 43 mins.



Operation 3

Mill chamfer.
Set-up ... 9 mins.
Milling (24 pieces) 27 mins.
Total 36 mins.

Continuous Production

—two automatic indexing fixtures with automatic clamping and unclamping.

Operation

Mill three slots in automobile transmission rings.
Production 300 per hour.

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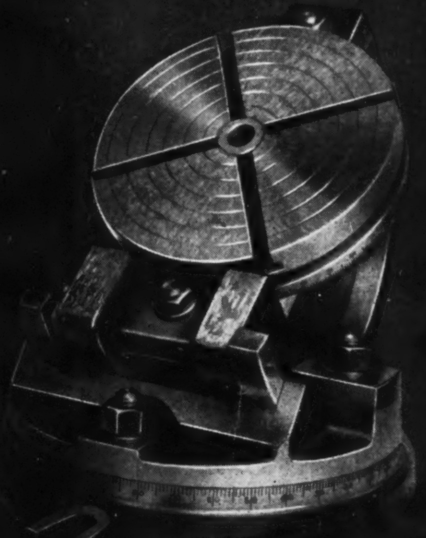
UNIVERSAL MACHINE VICES AND COMPOUND ANGLE TABLES FOR ALL ACCURATE WORK

Suitable for jig boring, grinding, milling and shaping machines. Movements are fully indexed through 360° in the horizontal plane and 90° in the vertical. Any combination of angles can be obtained.

Available with 4" and 6" jaw widths. Accurately indexed for angular work with spot sight and knife edge for register. Note the clean design, low height and rigid mounting. Angles cannot alter once the clamps have been locked.



Universal table fitted with interchangeable table. Changeover from circular to rectangular table is readily effected by loosening clamping bolts.
Available in two sizes. Circular 6" and 8" diameter. Rectangular 8" x 6" and 10" x 8".

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UV2

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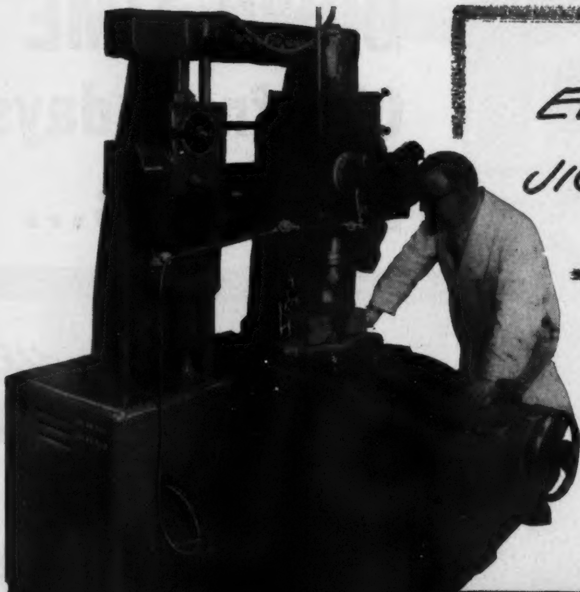
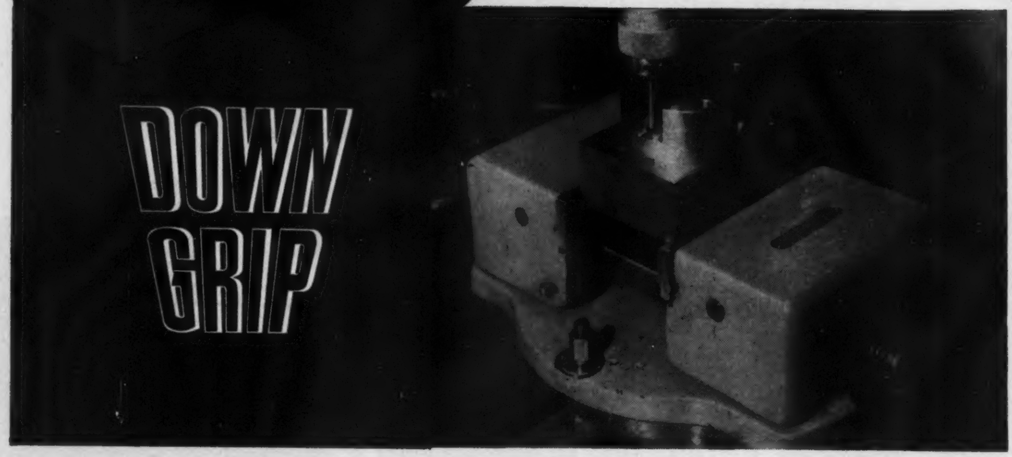
10" Double-Duo Precision Rolling Mill at Low Moor



EVEN ON A JIG BORER . . .

Here is a Machine Vice with built-in precision. As its name implies, it actually grips the work hard down on to its table or parallels. An accurate set-up in seconds!

The illustrations show the boring of a location pin hole in a fuel pump assembly fixture at the premises of Messrs. AC-Delco, Liverpool, by whose courtesy the photographs are reproduced.



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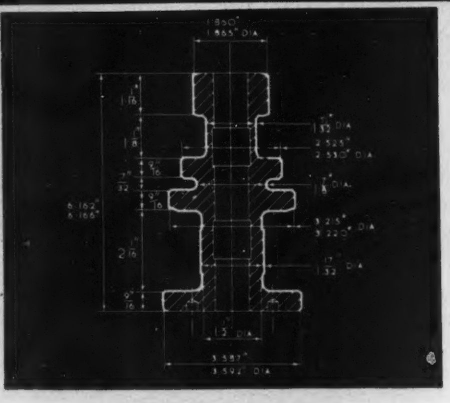


MACHINED IN 45 SECONDS

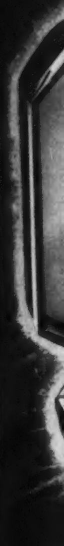
This 12-spindle No. 10 Ryder Verticalauto produces two machined transmission countershaft gears at each index.

Stellite and H.S.S. Tools cutting at moderate speeds and feeds have eliminated swarf problems and hydraulic operation of the mandrels and automatic hydraulic operation of the Loose Headstocks make loading easy to achieve within the cycle time.

Ryder

VERTICALAUTO

Thos. Ryder & Son, Limited, Turner Bridge Works, Bolton, England.
Makers also of single spindle Rydermatics and Piston Ring Lathes.

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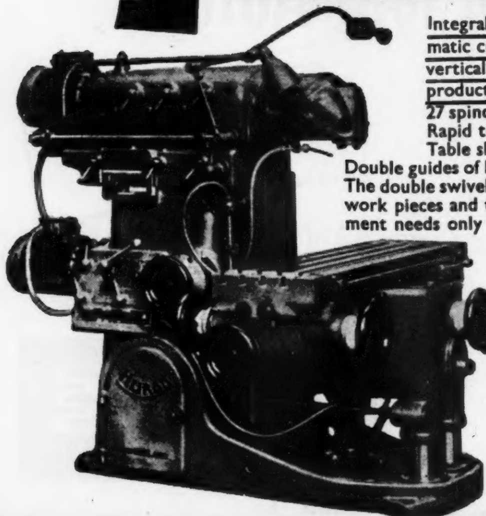


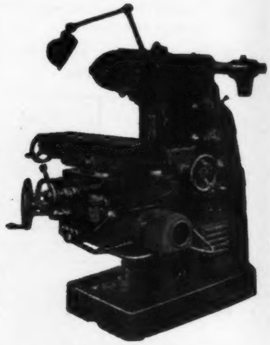
Integral double swivelling universal head provided with $27\frac{1}{2}$in. automatic cross feed by the sliding ram, can be set to the horizontal or vertical position, or to any angle instantaneously—permits the heaviest production cuts. Head can be retracted completely from table line. 27 spindle speeds from 30 to 2,066 r.p.m., 27 feeds from $\frac{1}{16}$in. to 30in. Rapid traverses in all directions. All operating controls duplicated. Table slides directly in the knee without cross movement or swivel. Double guides of knee permit components in excess of $1\frac{1}{2}$ tons to be machined. The double swivelling universal head requires an opening of only 14in. to enter work pieces and the whole sliding ram with its $27\frac{1}{2}$in. automatic cross movement needs only 18in. clearance. OPTIONAL EXTRA FEATURES: Mounted spacing casting assemblies providing additional 8in. capacity under spindle. 26in. wide 8 T-slot tables and $39\frac{3}{8}$in. automatic cross feed of sliding ram with special heavy duty knee and front operating position.

Type	Table	Automatic Feeds Long	Cross	Vert.
KU4	$56\frac{11}{16}$in. × $15\frac{3}{4}$in.	$43\frac{1}{4}$in.	$27\frac{1}{2}$in.	$19\frac{5}{8}$in.
KU5	$64\frac{9}{16}$in. × $15\frac{3}{4}$in.	$51\frac{1}{8}$in.	$27\frac{1}{2}$in.	$19\frac{5}{8}$in.
KU6	$78\frac{3}{4}$in. × $16\frac{1}{2}$in.	59in.	$27\frac{1}{2}$in.	$19\frac{5}{8}$in.
KU55	$64\frac{9}{16}$in. × 26in.	$51\frac{1}{8}$in.	$38\frac{5}{8}$in.	$18\frac{1}{16}$in.
L83	157in. × 59in.	118in.	$39\frac{3}{8}$in.	59in.

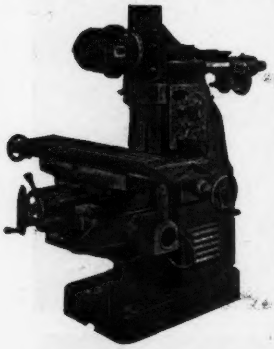
Type 'L' Open-side Traversing Head Universal Miller will mill, bore, slot and drill the largest work-pieces at one setting. The unique design permits greatest variety of operation on large work-pieces; the component remains stationary on the large work-table. Upright slides full length of base table and the sliding ram moves vertically and horizontally.

DUFOUR UNIVERSAL MILLERS

WITH DOUBLE UNIVERSAL SWIVELLING HEAD, RETRACTABLE SLIDE BRACKET AND SPACING CASTING GIVING 26" DAYLIGHT ON No. 59 AND 21" ON No. 61



FOR ALL MODELS Direct reading dial change for speeds and feeds. All parts subject to wear hardened and ground and completely interchangeable. Built to closest tolerances. Rapid traverses in all directions. Table swivels 30°. No. 40 taper for main horizontal spindle, double swivelling universal head, dividing head and rotary table. Hardened and ground centre guide for slideways. Twin overarms. Double swivelling sliding spindle heads with speeds 53-3000 r.p.m. Double swivelling universal head on retractable slide bracket providing with $5\frac{1}{2}$in. Spacing Casting Drive assembly on 59 Machine 26in. daylight, and 21in. on No. 61.



MODELS 53 & 61. 16 universal head spindle speeds 21-1600 r.p.m.; 8 horizontal spindle speeds 21-1180 r.p.m.; 8 automatic feeds $\frac{1}{2}$-$18\frac{3}{4}$in.

MODEL 59. 36 universal head spindle speeds 14-1780 r.p.m.; 12 horizontal spindle speeds 21-1180 r.p.m.; 16 automatic feeds $\frac{3}{8}$-20in.

MODEL 54. Automatic cross feed of universal head 20in.; 18 universal head spindle speeds 12-1500 r.p.m.; 36 horizontal spindle speeds 6-1500 r.p.m.; 18 automatic feeds $\frac{5}{16}$-$23\frac{5}{8}$in.

Type	Table	Automatic Feeds Long.	Cross	Vert.
53	$43\frac{3}{4}$in. × $9\frac{7}{8}$in.	$27\frac{1}{2}$in.	$9\frac{7}{8}$in.	$15\frac{3}{4}$in.
61	$47\frac{1}{4}$in. × $10\frac{1}{4}$in.	$30\frac{3}{4}$in.	$9\frac{7}{8}$in.	$15\frac{3}{4}$in.
59	$51\frac{3}{16}$in. × $11\frac{1}{4}$in.	$34\frac{1}{4}$in.	$11\frac{13}{16}$in.	$21\frac{5}{16}$in.
54	67in. × $14\frac{3}{4}$in.	$43\frac{5}{16}$in.	$14\frac{1}{8}$in.	$20\frac{7}{8}$in.

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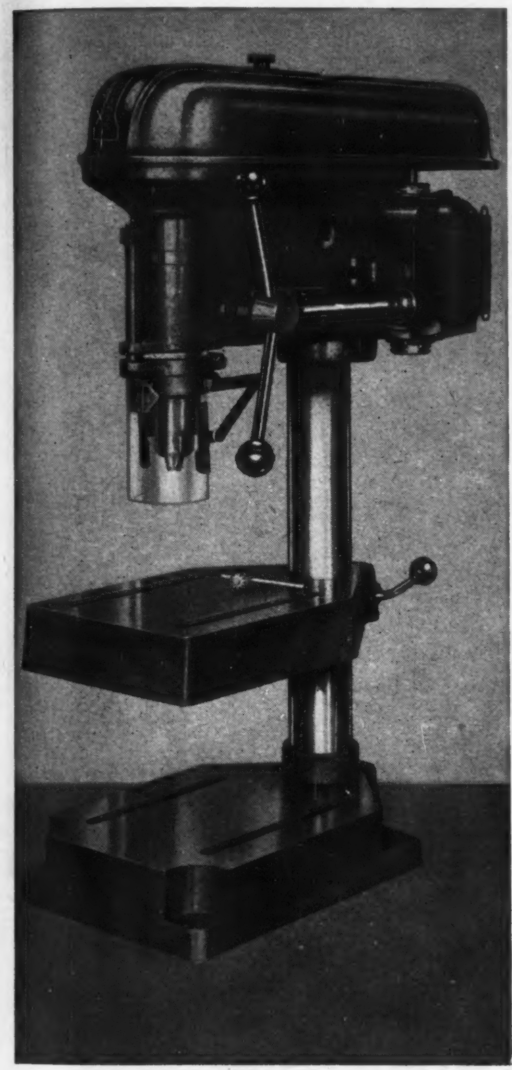
Telephone: CHISWICK 0514 & 6585. Inland Telegrams: RUDCAR, CHISK, LONDON. Overseas Telegrams: RUDCAR, LONDON.



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IN PRICE & QUALITY

- Weight 154 lbs. 70 kgs.
- Five Spindle Speeds
- Throat Depth $7\frac{5}{8}''$: 194 mm
- Column Diameter $2\frac{3}{4}''$: 70 mm
- Quill Diameter $2''$: 50·8 mm
- Robust Spindle and Quill Assembly with splined spindle and driving sleeve
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Supplied complete with 0-$\frac{1}{2}$in. Chuck, 3 phase motor, rotary on/off starter. Pedestal model £2.15.0 Extra. Single phase electrics £2.10.0 Extra.

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- ★ **Bedways hardened and ground**
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- ★ **Cam-lock spindle nose**
- ★ **Swings 19½" in gap without removal of gap-block**
- ★ **Hardened and ground gears**

Swing over bed	14"
Swing in gap	19½"
Distance between centres ...	40" - 60"
Spindle speeds (9)	45-1,500 or 54-1,800 r.p.m.

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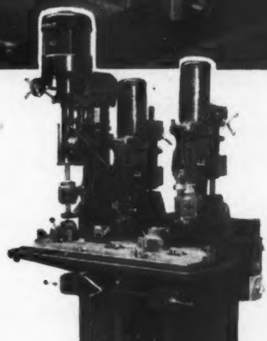
NRP 3474

Herbert 3-spindle Drilling Machine, complete with fixtures and drill heads to drill, counterbore and tap an immersion thermostat.



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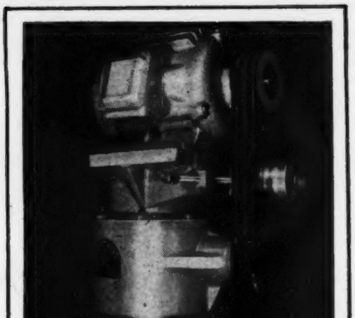
Heliocentric may be the answer to your power transmission problems—range of ratios 20:1 to 512,000:1. Horse power 1/6 to 30.

Please write for illustrated brochure to Department H.G.



Motorised Heliocentric Speed Reducer, ratio 280:1 designed for synthetic fibre extrusion plant

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Two Models

- **WITH MANUAL CROSS MOVEMENT OF WHEELHEAD**
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Capacity between centres	72″
Height of centres	$6\frac{1}{4}$″
Cross travel of wheel head	12″
Grinding wheel speeds. ...	2800 & 5600 r.p.m.
Workhead speeds. ...	130, 180, 230 and 320 r.p.m.

- **For all types of circular, flat and spiral broaches up to 72 in. long.**
- **12 in. cross travel of wheelhead accommodates wide flat broaches.**
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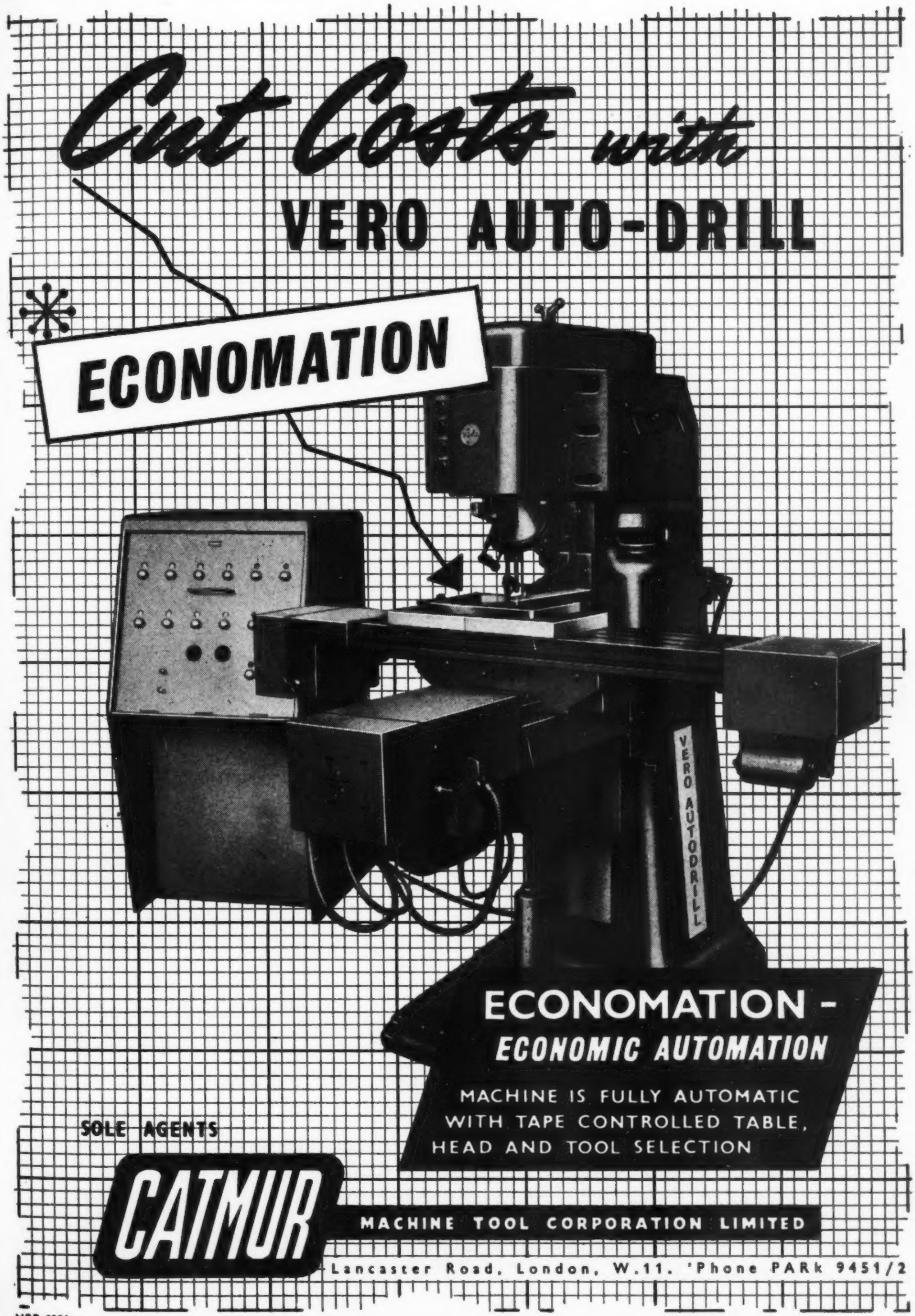
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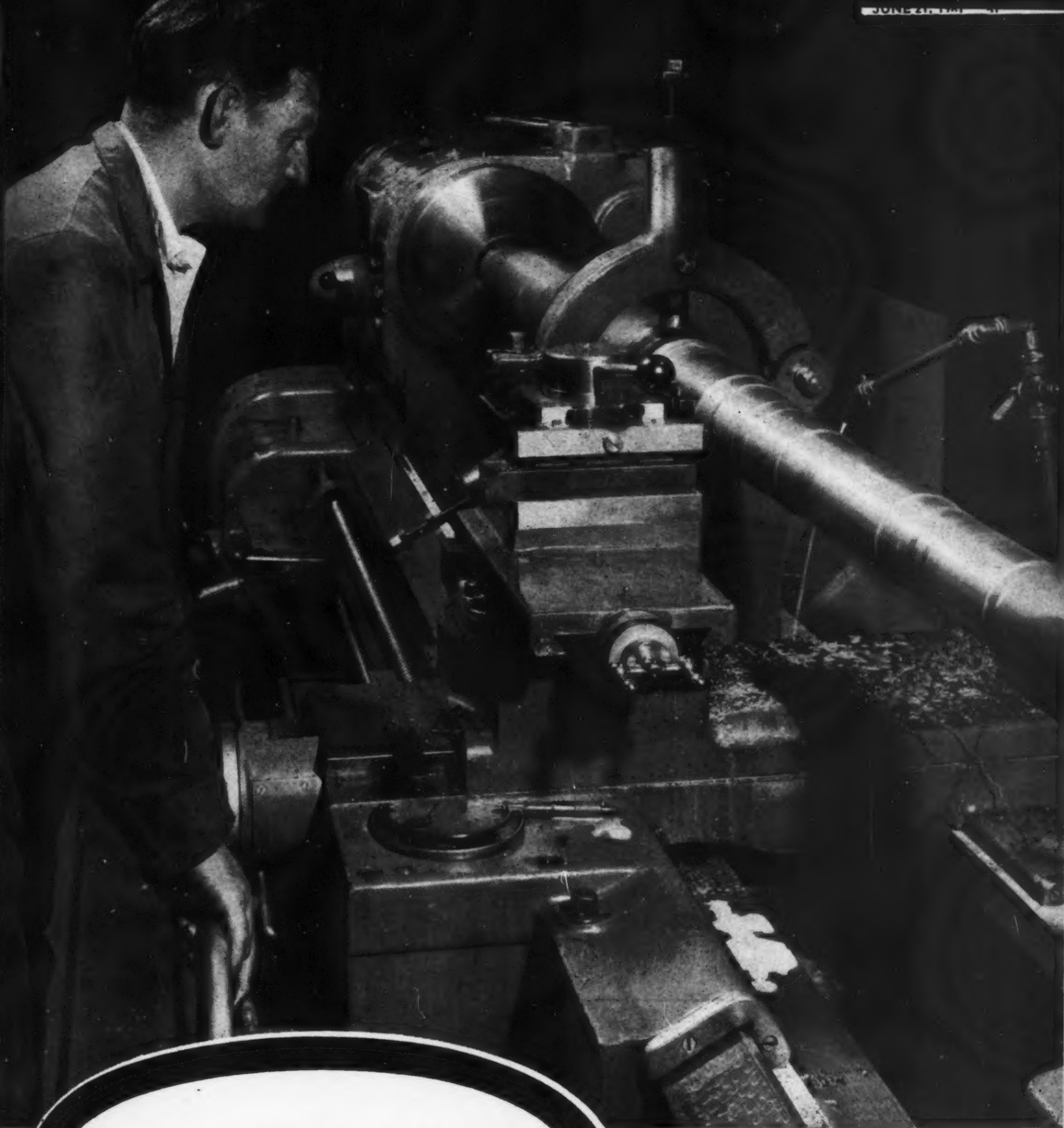

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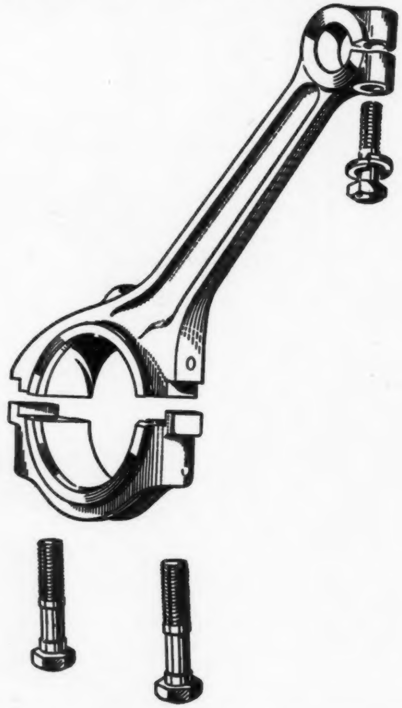

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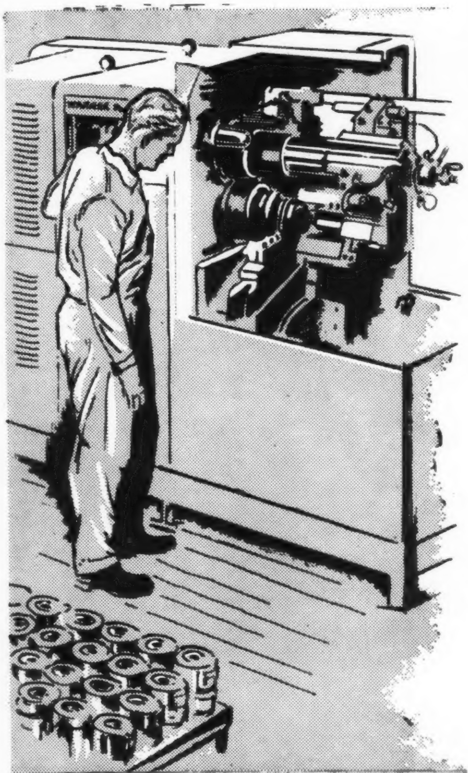

2AC *Automatic*

for Versatile Production

This single spindle chucking automatic is more versatile than a hand-operated machine, it does more complicated work—automatically. You complete more jobs on the 2AC, fewer second operations are needed and standard tool and machine functions will handle most work.

Built-in rigidity and accuracy are features that ensure the holding of close tolerances and speeds and horsepower permit effective use of today's most advanced cutting tools. Because of their fast set-up features batchwork can be produced more profitably on an automatic basis. A 12" air operated chuck is fitted.

The production example below demonstrates:-

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2. **Automatic Feed and Speed Changes** permit multiple drilling the four holes.
3. **Threading Ability** is shown.
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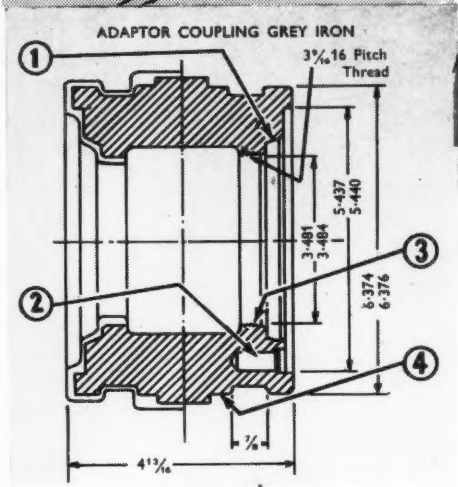

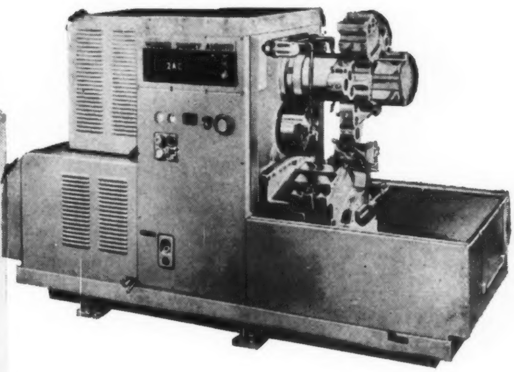

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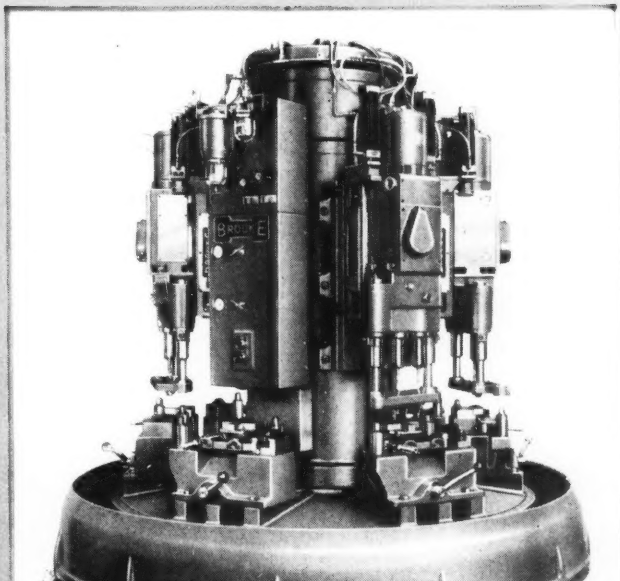

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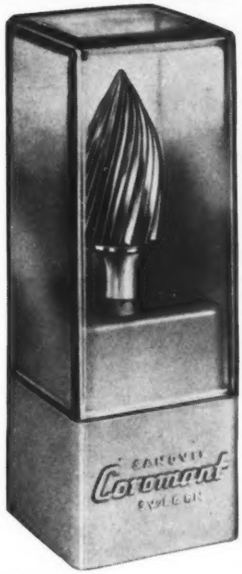

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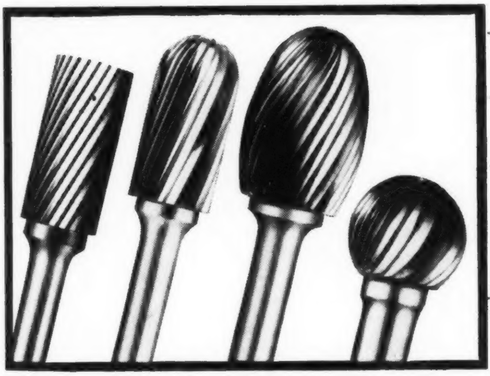

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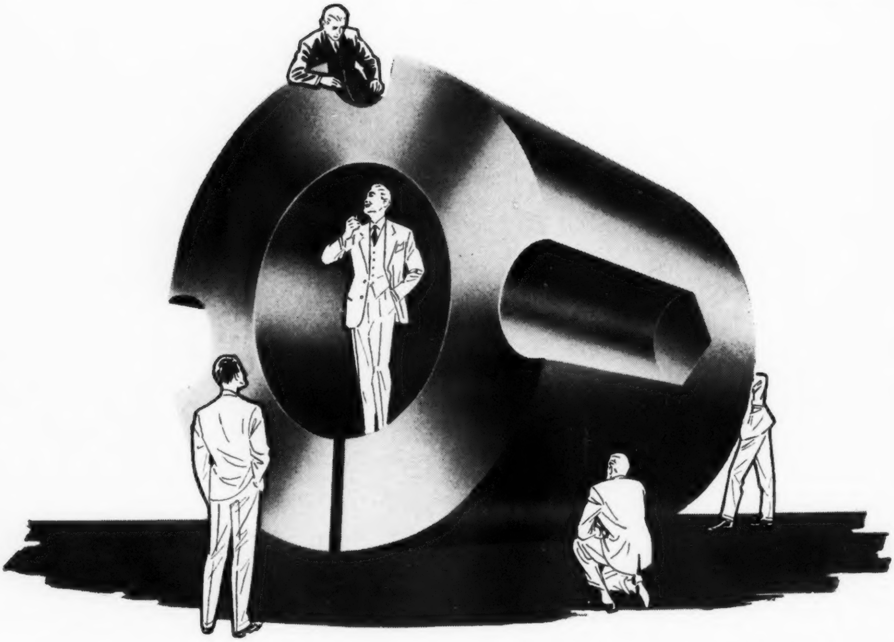

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- ***Made from solid forgings of nickel-chrome-molybdenum steel***
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The press brake is illustrated

$\frac{3}{8}$in. capacity **GUILLOTINE** with a cutting width of 8ft. 4$\frac{3}{8}$in. Complete with hold-down and calibrated rack and pinion adjusted back gauge.

200 tons **PRESS BRAKE** with a forming capacity in mild steel of $\frac{1}{4}$in. by 13ft. 11in. over a 2in. vee die opening, or $\frac{1}{2}$in. by 65in. over a die opening of 4in. All-steel construction.

Both machines are motorised for 415 volts, 3 phase, 50 cycles supply.

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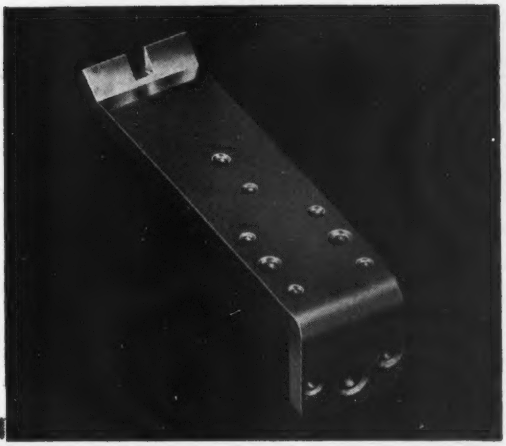

Pole Piece: 11 close-pitched holes drilled; 5 different diameters; 1 hole drilled and counter-bored from angular side-head . . . and the output rate is 300 per hour . . .

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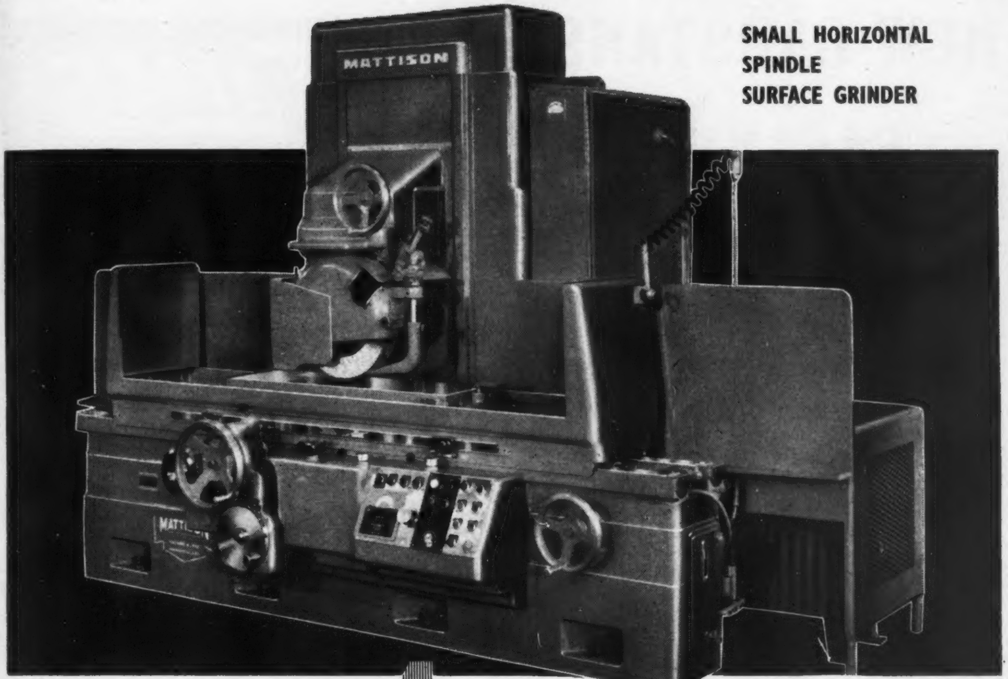
SMALL HORIZONTAL
SPINDLE
SURFACE GRINDER



NEW MATTISON SURFACE GRINDER
gives 4 way improvement!

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Through new design of base, table columns, cross slide and hydraulics.

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Automatic reset, optional automatic downfeed and optional power table positioning.

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Through isolated hydraulic system and rugged construction.

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New features improve protection of parts and reduce cost of servicing.

For closer tolerances and finer finish on production operations, greater precision is now available in this highly improved surface grinder. The new line of Mattison grinders represents a comprehensive improvement of what was already the best horizontal machine on the market. Send for full data—now!

NRP 3425

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WITH THE "Voucher-57" PNEUMATIC SAW MACHINE

CAPACITY 2⅜" or 3" BARS OR TUBES

DEAD SQUARE CUT: NO WORK HARDENING. NO DUST. NO FRAZE.

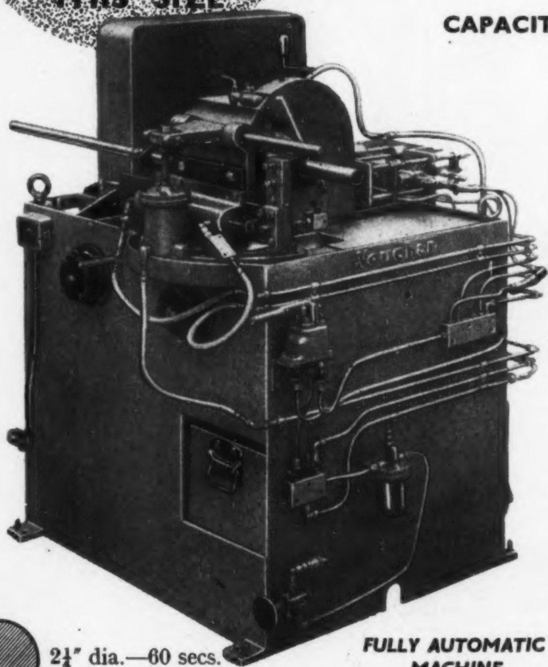
FIXED OR VARIABLE SPEEDS.

FIXED WORK POSITION FOR RIGID CONTROL.

THE WORK IS GRIPPED ON BOTH SIDES OF THE SAW BLADE, WASTE ENDS ELIMINATED.

FULLY AUTOMATIC MACHINES WITH MAGAZINE FEED FOR COMPONENTS UP TO ANY LENGTH.

SEMI-AUTOMATIC MACHINES FOR ALL LENGTHS.



FULLY AUTOMATIC MACHINE

2¼" dia.—60 secs.
1" dia.—12 secs.

2" × 3/16"—10 secs.
1" × 3/16"—3 secs.

2" square—50 secs.
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We can also offer standard or special purpose machines for screwing or cutting-off or both. May we quote you?

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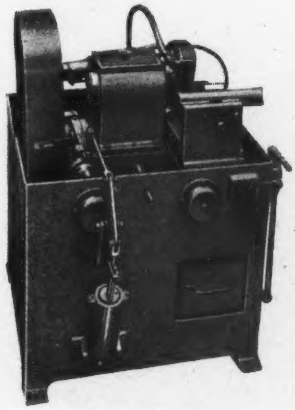

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For Milling Machines

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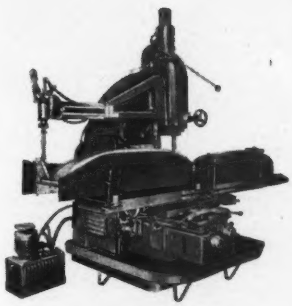

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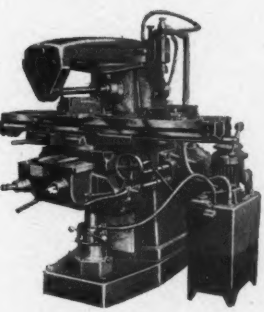

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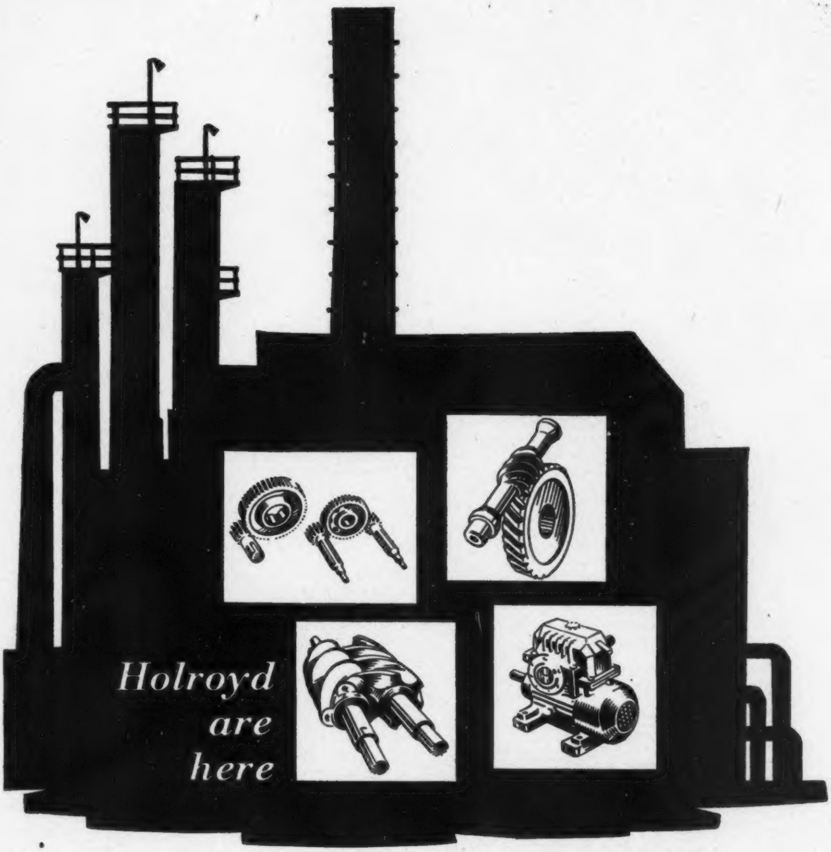
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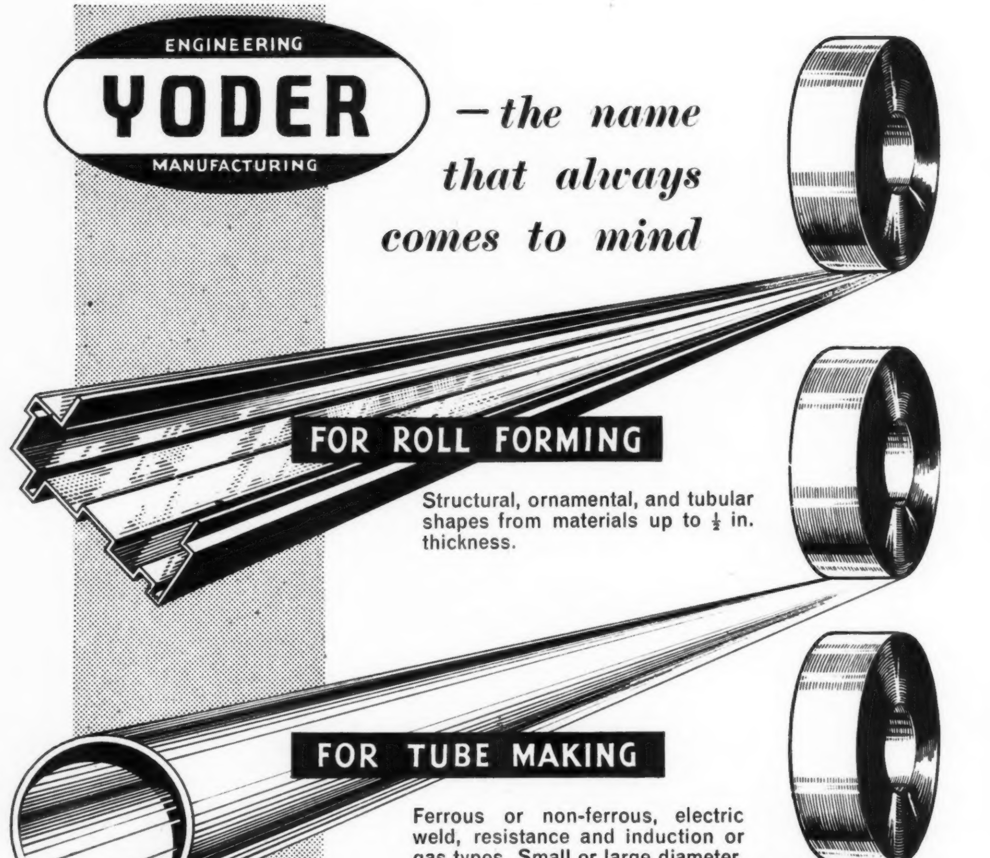
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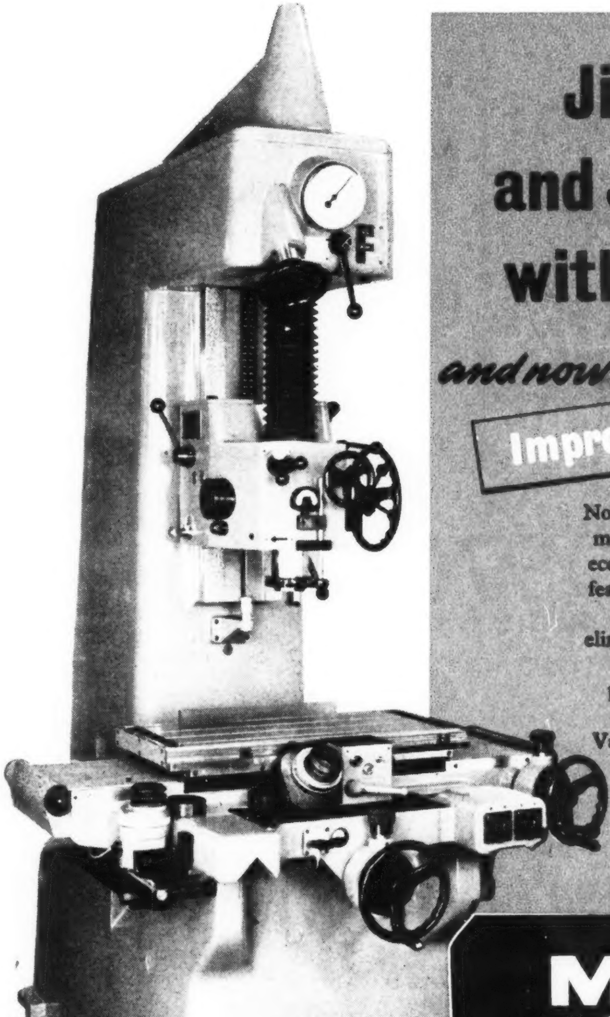

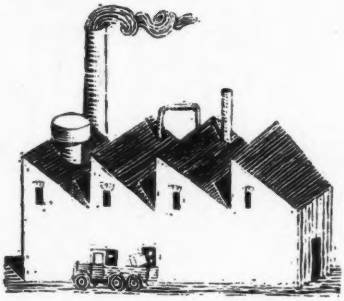

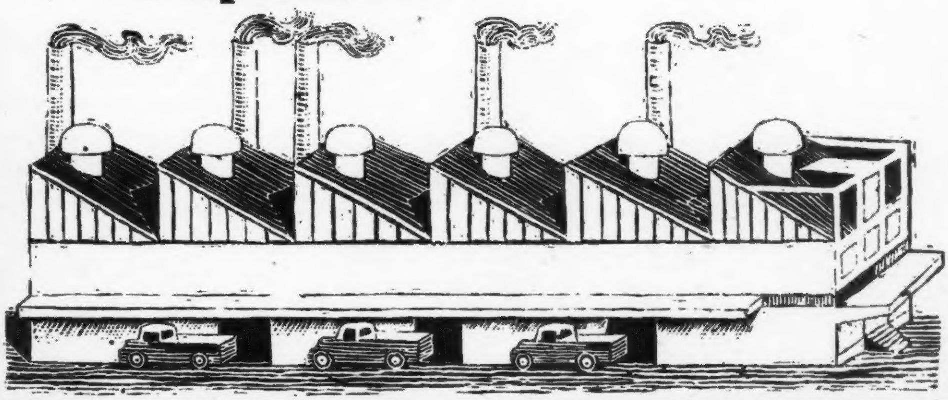

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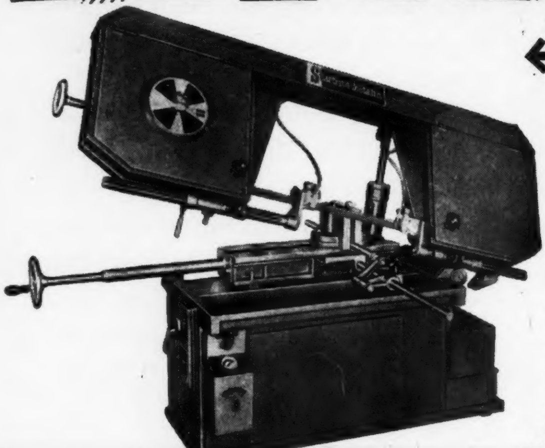

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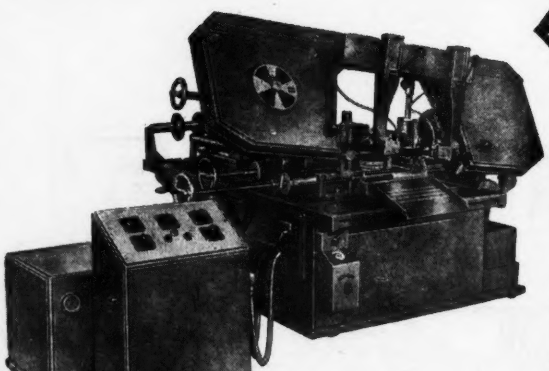

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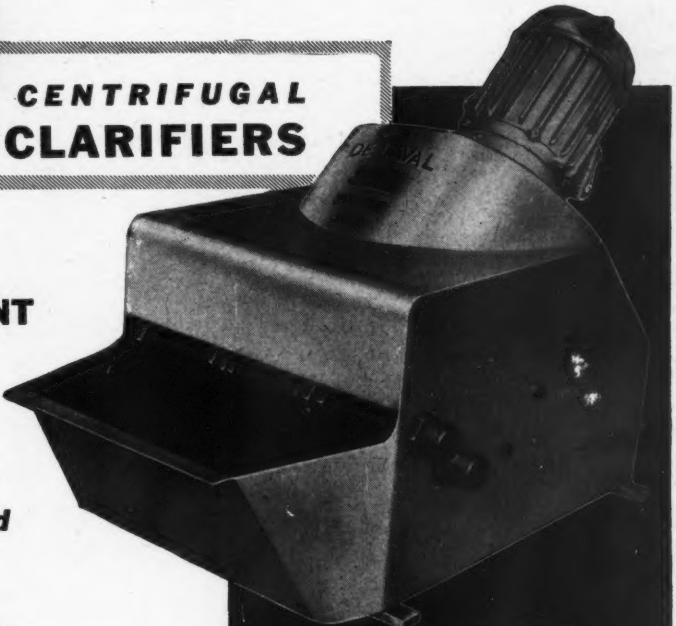

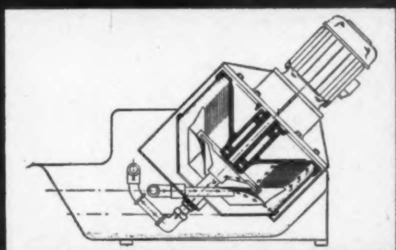

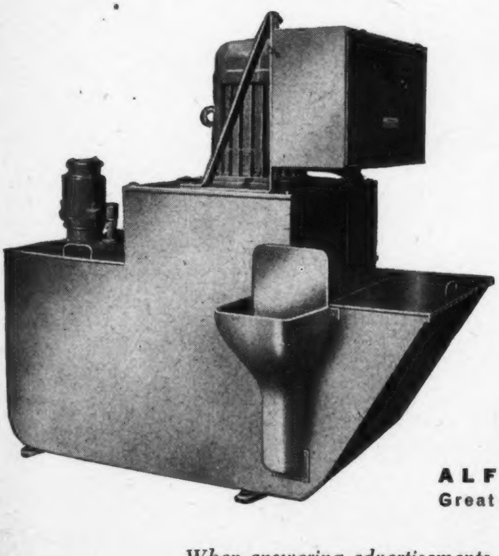

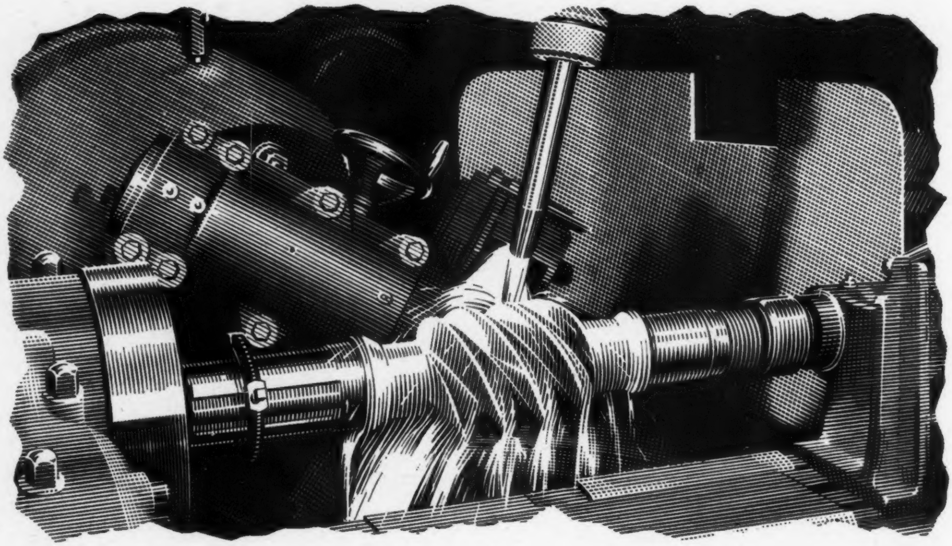

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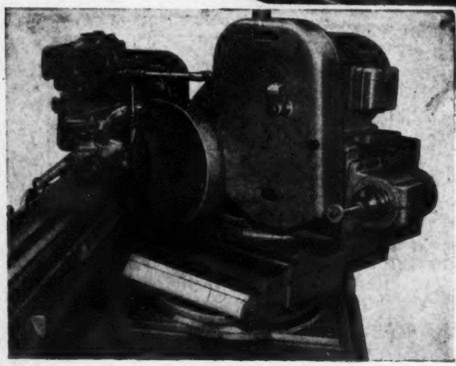

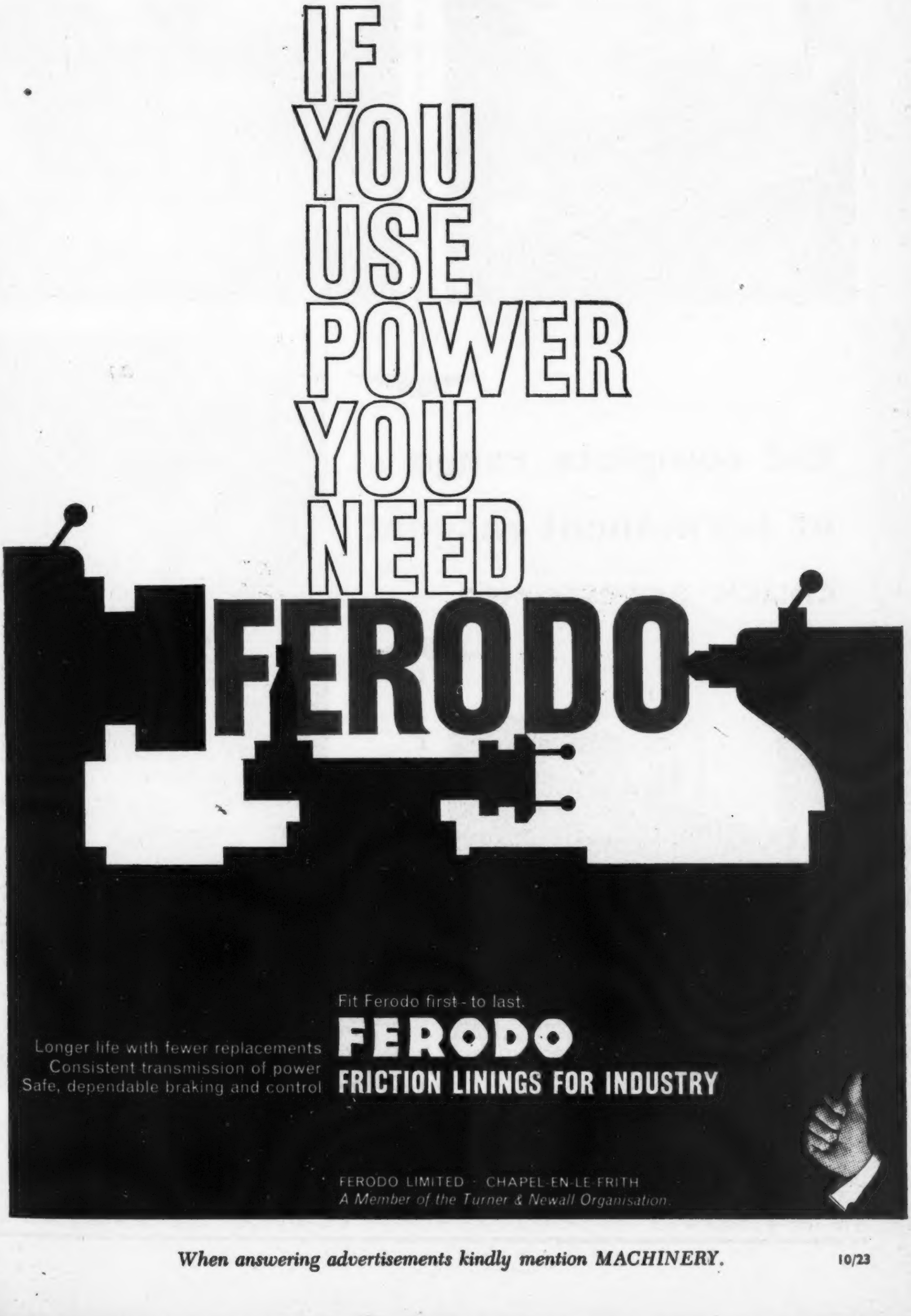
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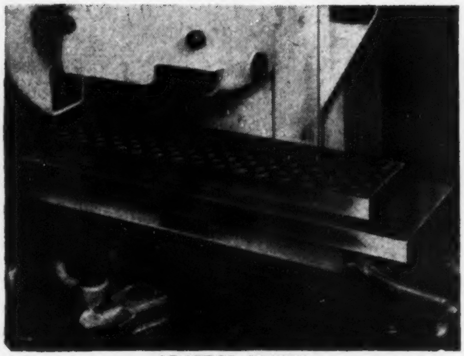
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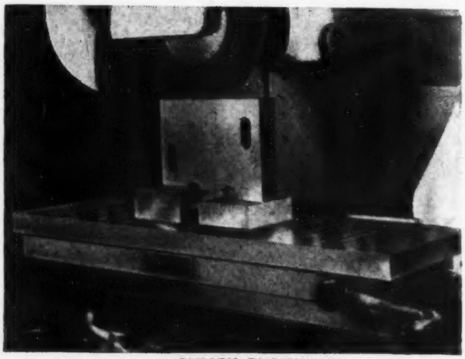
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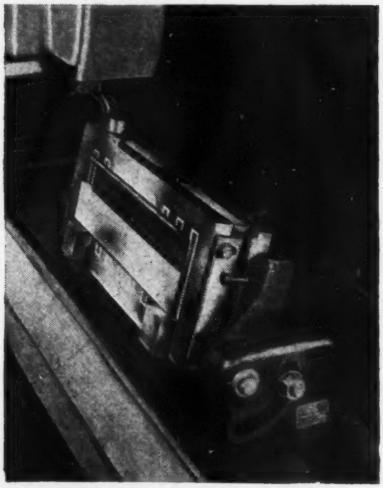
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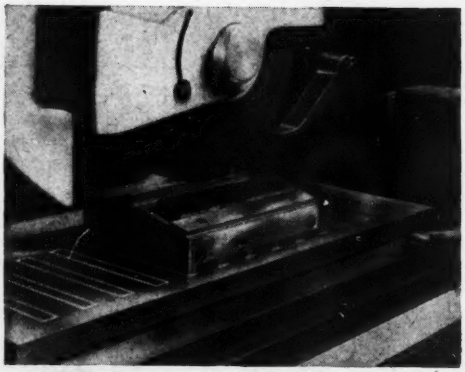
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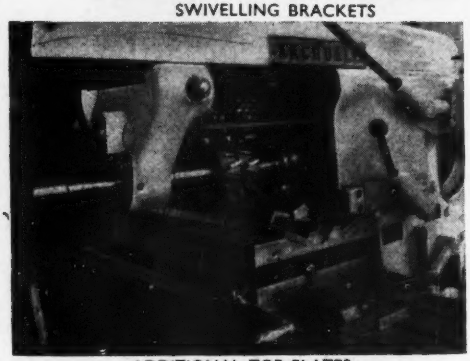
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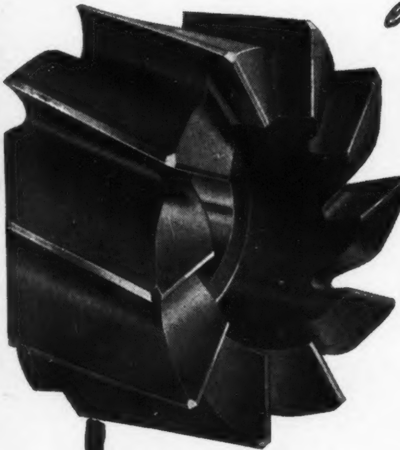

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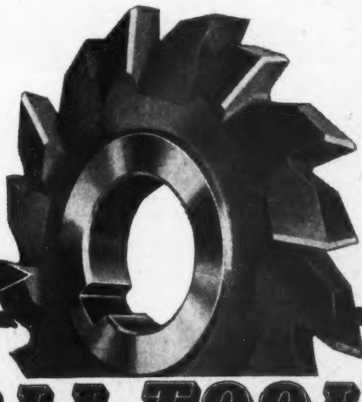

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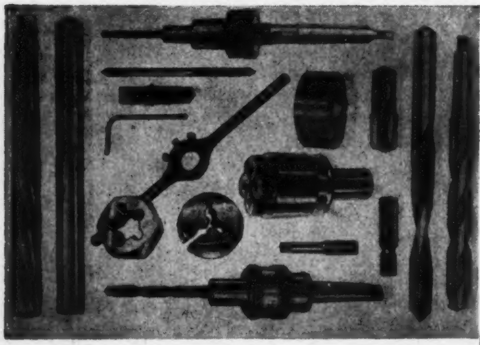

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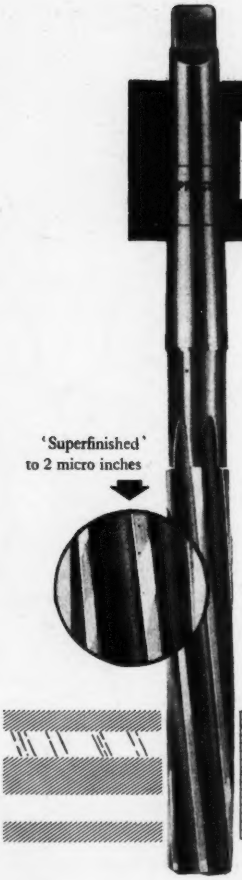

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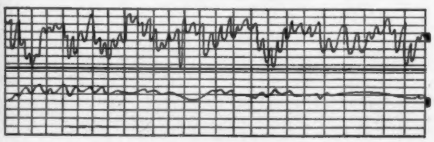

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Vol. 98, No. 2536 June 21, 1961

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Abstracts of Principal Articles

Making Components for Type Casting and Composing Machines .. .. P. 1392

Notch bars for the indexing systems of "Lithoprintex" Senior Step and Repeat Machines are produced by the Monotype Corporation, Ltd., Salfords, Redhill, Surrey, with the aid of a special fixture. The work-carrying slide of this fixture can be positioned to close limits for successive notch milling operations with the aid of length bars and a fiducial indicator. After milling, the bars are checked on a gauging fixture which incorporates a stylus finger and a fiducial indicator, and the work is positioned relative to the slide carrying these units with the aid of length bars. Conjugate cams for Filmsetter Type Casting and other machines are cut in pairs on a special milling machine designed and built by the Monotype Corporation. The workhead is arranged to pivot, under the action of a pair of master cams, and the work profile is machined with a cutter that has helical carbide teeth. The company has used high-rake milling for a number of years, and high-rake slab mills are employed for a variety of machining operations, including the milling of a step in a block of En.32B steel, whereby 0·574 cu. in. of metal is removed in 25 sec. (MACHINERY, 98—21/6/61.)

The A.E.I. Blading Works at Larne P. 1402

Adjacent to the heavy-machining and erection section of the A.E.I. turbine-generator works at Larne, Northern Ireland, there is a separate 65,000-sq. ft. building which is devoted exclusively to the production of turbine blades. A very wide range of blades of different designs is produced, the smallest being 1¼ and the largest 39¼ in. long. In this article, details are given of a special Holroyd 4-station blade milling machine, which operates on the direct copying principle, employing a master blade that is three times as large as the finished workpiece. Other set-ups described include plunge-milling concave surfaces on a Sundstrand machine, and copy-milling convex surfaces on a Heller horizontal mill. (MACHINERY, 98—21/6/61.)

Rheem Numerical-control Positioning System .. .. P. 1411

A feature of the numerical control system developed by the Electronics Division of the Rheem Manufacturing Co., Los Angeles, Calif., is that decimal dimensional information can be punched directly into paper tape without the need for converting such data into a binary code, for example. The holes in the tape are scanned by a photo-electric arrangement, which automatically sums individual columns and thereby builds up the digits of a number. The system has been applied to machine tools, including an Ex-Cell-O twin-head borer on which it controls the radial position of a tool in addition to the main machine movements. Details are also given of the system as applied to a Burgmaster turret-type drilling machine. (MACHINERY, 98—21/6/61.)

Chinese Machine Tools at the Leipzig Fair .. .. P. 1415

Twelve machine tools of various types, of which six were grinding machines, were shown in the Chinese permanent pavilion at this year's Leipzig Spring Fair, in addition to a variety of other equipment stated to have been made in China. The machine tools included a sliding-head automatic and a large, 3-way multi-spindle drilling machine for operations on large internal-combustion engine crankcase castings. Of the grinding machines, an internal type with three spindles in an indexing drum with provisions for automatic loading, transfer to the working position, and unloading, was of interest. A large thread grinder, and machines for plain cylindrical, centreless, optical profile and gear grinding were also shown. A plain gear hobber, and a spiral bevel generating machine for curved-tooth bevel and hypoid gears attracted attention, and there was also a large jig borer with a measuring system incorporating scales in the form of helical lines on cylindrical bars. An electro-impulse machining unit of new design, employing a special impulse generator, was demonstrated. (MACHINERY, 98—21/6/61.)

Stores Control System for Bought-out Parts P. 1429

At Corran Works, Ltd., Larne, Northern Ireland, a stores control system has been installed whereby close and effective control is exercised over the receipt, storage, and issue of more than 4,500 different types of bought-out parts, which are ordered in batch quantities between 500 and 1,000. The parts are placed in trays which are stored at random, thereby ensuring even distribution within the area and efficient utilization of storage space. Details are given of the salient features of the system, including the special cards which are used to facilitate speedy location of stored parts. (MACHINERY, 98—21/6/61.)

The New Herbert Applied Research Department .. .. P. 1433

The new Applied Research Department at the main works of Alfred Herbert, Ltd., Coventry, was opened by the Rt. Hon. Reginald Maudling, M.P., President of the Board of Trade, on June 20. This department is housed in a building that has been designed to reduce the influence of temperature variations, and is divided into a Mechanical Section and an Electrical Laboratory. The Mechanical Section is in two bays, served by overhead cranes, and provides for machining components, for new machines and equipment, and testing prototype machines and assemblies. Associated control units and systems are developed in the Electrical Laboratory, adjacent to which there is office accommodation for the research staff. (MACHINERY, 98—21/6/61.)

EDITORIAL

Investigation of the Spark-hardening Process for Cutting Tools

In view of the many problems to be solved in connection with the machining of a constantly increasing range of metals and alloys, and the very exacting limits for dimensional accuracy and surface finish of workpieces which are now frequently specified, all developments leading to improved performance of cutting tools deserve careful study with a view to their adoption wherever advantages are to be gained. Much progress has, of course, been made in recent years in connection both with tool materials and methods of treatment, and as a result, metal removal rates have frequently been greatly increased, and work quality improved. One process, to which reference has previously been made in MACHINERY, provides for the formation of a hard layer on the surfaces of steel tools by the action of electric sparks, and it is claimed that in this manner a high degree of wear resistance can be imparted while retaining the shock resisting properties associated with such tools.

Equipment for applying the treatment is available in this country and good results have been reported. It is understood, moreover, that considerable importance is attached to the process in the U.S.S.R., where it has been utilized for increasing the durability of various machine components in addition to cutting tools.

To produce the spark-hardening action, an electrode is vibrated so that it makes intermittent contact with the work surface, and as was pointed out by Dr. N. C. Welsh, Ph.D., B.Sc., and Mr. P. E. Watts, B.Sc., in a paper presented to The Iron and Steel Institute,* the result obtained is due partly to the rapid chilling of the small volumes of metal fused by the sparks, and partly to the effects of absorbed atmospheric gases. Principally, however, the surface hardening is attributable to the transfer of material from the electrode to the work. Normally, the electrode is of sintered carbide, and as a result of sparking a thin layer on the surface of the workpiece becomes enriched with transferred carbide and may attain a hardness level approaching that of the electrode.

This treatment can undoubtedly be effective, but investigations which have been carried out by the authors have shown that unless certain precautions are observed the full potential advantages may not be gained. It has been found, for example, that when hardened high speed steel is treated by the spark process, although the hardness of the extreme outer layer may be intensified, depending on the conditions, in an intermediate layer appreciable softening occurs. This softening—which also takes place when hardened plain carbon steel is treated—it is thought, is not attributable to general or local tempering of the subsurface layer as a result of heating caused by the sparks, but to the formation and retention of austenite. It seems likely that the presence of a softened intermediate layer beneath the very thin, superhardened, surface would adversely affect the performance of a tool in service.

Attempts were made, without success, to restore the hardness of the softened zone by sub-zero treatment. It was found, however, that with high speed steel the desired result could be obtained by heating to a temperature within the range normally employed for secondary hardening. Subjection of spark-hardened tools to such treatment may, therefore, it is suggested, prove of benefit in practice. On the other hand, if the tool was required to be spark hardened periodically, following regrinding, the restoring treatment would be likely to cause some progressive reduction in the hardness of the body of the tool.

Owing to the fact that the spark-hardened layer is very thin, it is not normally possible to do more than lightly hone the surface after treatment. Moreover, unless precautions are taken, the process has an erosive action on the extreme edge of a cutting tool. For this reason, it is stipulated by Russian authorities that the electrode must not be allowed to approach the edge too closely, and they recommend that an adjacent band, 0·2 to 0·4 mm. wide, should not be treated. The authors of the paper suggest, however, that whereas the most severe wear on a tool sometimes occurs at a distance from the edge, in general it is at the extreme edge that maximum protection is required. Based on their investigations, moreover, they put forward a simple solution to the problem of treating a tool surface right to the edge, without risk of erosion.

The necessary protection, it has been found, can be provided merely by clamping a second piece of

(*Continued on page* 1442)

* This paper was published in the Journal of The Iron and Steel Institute for May, 1961.

Making Components for Type Casting and Composing Machines

Methods and Equipment Employed by the Monotype Corporation, Ltd., Salfords, Redhill, Surrey

By P. A. SIDDERS, Chief Associate Editor

IN AN EARLIER ARTICLE,* reference was made to the "Monophoto" Filmsetter which has been developed by the Monotype Corporation, Ltd., Salfords, Redhill, Surrey, for the production of lines of text by photographic means, directly on to film or sensitized paper. The operation of the machine was briefly described, and the production of components for matrix case assemblies was considered in some detail. "Monophoto" machines are intended principally for the production of plates for printing by the photolithographic or photogravure processes, which are now being used on an increasing scale. During the past few years, the extended use of printed packages and containers has resulted in a demand for an associated machine which can produce, at high speed, multi-image plates of high quality. Such machines are built by Pictorial Machinery, Ltd., a subsidiary of the Monotype Corporation, Ltd., and the latest type, marketed as the "Lithoprintex" Senior Step and Repeat Machine, has been developed jointly by the two companies. This machine has been designed to speed up plate production and to accommodate plates in sizes suitable for the larger presses that are now in operation.

Basically, a Step-and-Repeat Machine, as its name implies, functions by the repeated projection of an image from a master negative on to sensitive material, the latter being mounted on an easel which can be accurately indexed. Indexing must be carried out to very close tolerances in two directions mutually at right angles, and is performed with the aid of micrometer units, graduated in 0·001-in. increments, which are used in conjunction with notch bars. The notch bars provide for 1-in. indexing movements, and are made in 6-in. lengths, from En.8 steel. A typical bar is seen at the right in Fig. 1, and bars are assembled on the "Lithoprintex" Senior machine to form 78- and 54-in. units, the maximum allowable tolerance for spacing over the full lengths being maintained within very close limits.

Material for the production of notch bars is supplied in the normalized condition, and the operation sequence provides for rough grinding all faces; straddle milling roughly to length; rough milling the notches; drilling, counterboring and tapping; stabilizing; straightening, de-burring and filing chamfers; rough and finish grinding to length, thickness and width; cross grinding the front face for appearance; and finish milling the notches. No further operations are performed on the notches, but one end of the bar is ground in relation to a notch face, and the other end is

Fig. 1. A notch bar for the indexing system of a "Lithoprintex" Step and Repeat machine is seen at the right, with a cutter employed for finishing the notches at the left

* MACHINERY, 98/988—3/5/61.

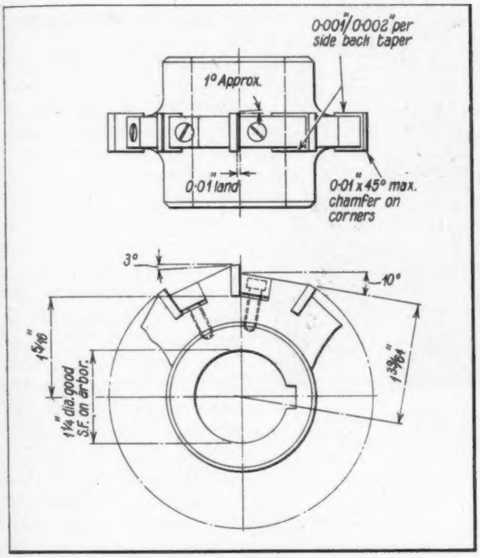


Fig. 2. **Details of the teeth of the cutter employed for milling notch bars are here shown**

then ground to provide a specific overall length.

Notch milling is carried out on a Kearney & Trecker Milwaukee type 3K horizontal machine, with the cutter seen at the left in Fig. 1, and details of the teeth are given in Fig. 2. The cutter, of 3½ in. diameter, is of the alternate side-and-face type. Made by the Monotype Corporation, it has ten inserted tungsten carbide teeth, for which Prolite grade 4T tips (½ by 7/16 by ⅛ in.) are employed. The tips are clamped in the cutter body by wedge blocks and socket-head screws, and the cutting edges are finished by lapping with a diamond wheel.

Limits of $\pm 0{\cdot}0002$ in. are specified for the position of the left-hand side face of each notch from the left-hand end of the bar (all as viewed in Fig. 1), and the fixture employed for milling the notches is seen in Fig. 3. A heavy cast-iron base *A* is located transversely on the machine table by tenons, and incorporates dovetail guideways for a work-carrying slide *B*. This slide is cast with an integral sloping swarf deflector tray *C*, and a rectangular-section groove is machined along the length of the main body portion. An L-section steel strip, hardened and ground, is fitted at one side of this groove (to the rear as viewed in Fig. 3), and a stop bar is secured to the top of the slide, as indicated at *D*. A workpiece is loaded into the fixture with the un-notched edge resting on the horizontal face of the L-section strip, and it is moved endwise to bring the larger end face (at the left in Fig. 1) into contact with the stop bar *D*. The work is clamped against the vertical face of the L-section strip by two steel blocks, which are free to slide and are thrust towards the work by the hand knobs *E*. In order to provide maximum support for the work and clearance for the cutter, the vertical portion of the L-section strip is machined to a castellated form.

Movement of the slide on the fixture base is effected by a screw, of 0·1 in. pitch, which is connected to the handwheel *F*. This handwheel is employed for coarse adjustment, and for fine setting, the screw can be coupled to a small worm drive unit *G*, by turning the knurled knob *H*, in a clockwise direction. Drive is then imparted to the screw by rotating the knurled knob *J*.

The slide is set approximately for milling each notch in the workpiece by means of a scale on the

Fig. 3. **The fixture which has been designed and built by the Monotype Corporation, Ltd., for positioning notch bars for finish milling the notches**

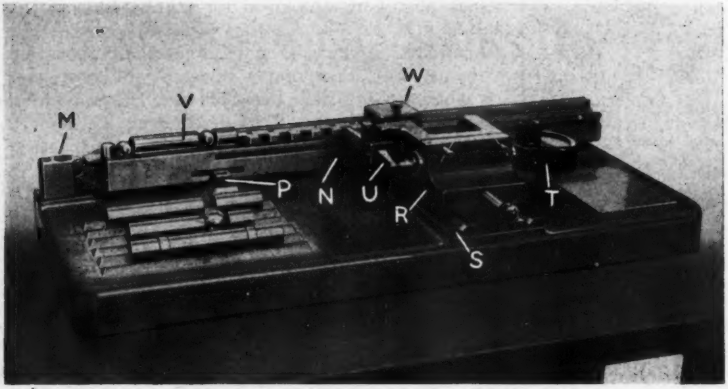


Fig. 4. This equipment is used for checking the notch bars after the notches have been milled, and incorporates a fiducial indicator. The work is located by means of length bars

fixture base, which is read with reference to a datum mark. A Johansson fiducial indicator is provided for final setting, and is held in a bracket mounted on the fixture base. This indicator is calibrated in 0·0005-in. increments, and is used in conjunction with P.V.E. cylindrical length bars. Six bars with lengths from 1 to 6 in. inclusive, in 1-in. steps, are used, and for milling the open-end notch (at the right in Fig. 1), the 6-in. bar is used, as seen at *L*. The bar is supported in a V-groove in the fixture base, and one end is engaged by a hardened pad on the slide, the other end making contact with the stylus point of the indicator. Adjustment of the slide is carried out until a zero reading is obtained on the indicator. The slide is re-set successively after each milling operation, using progressively shorter bars, adjustment being carried out for each setting until a zero indicator reading is obtained. Once the slide has been set, it is locked in position by a lever-screw, at the rear, which applies pressure to the gib strip. At the start of the milling operations on a batch of parts, the machine table is adjusted crosswise, by trial, to give the correct distance from the vertical shoulder face of the open-end notch to the stop bar *D*.

Milling is performed at a cutter speed of 61 r.p.m., and a feed rate of 2 in. per min., and approximately 0·007 in. of metal (a side) is removed from the rough-milled component. Soluble oil coolant is used and about 40 bars are milled between regrinds. In order to maintain constant conditions, all lubricating oil from the machine is delivered from, and returned to, a large-capacity auxiliary tank, and the machine is run for a considerable period before cutting is started.

CHECKING NOTCH BARS

Notch bars are subjected to 100 per cent inspection for position of the datum faces of the notches, with the equipment seen in Fig. 4. A well-ribbed cast iron baseplate is fitted with a steel pillar *M*, to which a support bar *N* is hinged by means of two pairs of crossed-axis, leaf spring pivots. The support bar is of steel, hardened and ground, and is mainly of L-shaped cross-section, with a V-groove extending along the upper face of the horizontal limb of the L-form. Ground pads on the baseplate support the bar at the Airy points, and it can be secured to these pads by socket-head screws and clamp blocks, as at *P*. This method of mounting has been adopted to provide for angular adjustment of the bar, to ensure that it is always precisely at 90 deg. to the axis of motion of the carriage *R*.

This carriage is supported on three accurately-matched steel balls, which roll in V-grooves in steel strips, as at S, screwed and dowelled to machined facings on the baseplate. There are two balls in the groove of the left-hand strip, which are engaged by the V-groove in a steel insert at the left-hand side of the carriage. A single ball in the groove of the right-hand strip is contacted by a flat steel insert at the right-hand side of the carriage. It will be understood that all the strips and inserts are hardened and ground. Pins are inserted in the strips to limit the movement of the balls.

On the carriage is mounted a Johansson fiducial indicator *T*, of the same type as is used on the milling fixture. The stylus point of this indicator contacts one end of a sensing finger *U*, which is attached to crossed-axis, leaf-spring pivots, on a support block fitted to the carriage. A rectangular steel frame is fitted to the block and carries two opposed grub screws, which serve to prevent excessive movement of the sensing finger. The indicator is mounted in a split-type clamp, which permits axial adjustment.

This fixture was originally designed for checking 12-in. notch bars, but it is used for the 6-in. bars by employing two length standards and carefully calibrated steel balls. At one end of the V-groove in the support bar *N* there is a hardened

and ground steel pin, and for setting the fiducial indicator to zero, a 1-in. ball is placed in the V-groove, in contact with the pin. A 5-in. length bar, a ½-in. ball and a 4-in. bar are then placed in the groove, and brought into contact, before the sensing finger is applied to the end face of the shorter bar. The 1-in. ball is then replaced by a ½-in. ball, and a notch bar is placed on the support bar so that it spans the V-groove, with its smaller end in contact with the shorter length bar, and its un-notched edge against the ground face of the vertical limb of the L-form. A block *W* is free to slide along the support bar, and can be clamped to it by means of a knurled-head screw and a pad. This block houses a spring plunger, and it is positioned on the support bar so that the plunger applies pressure to the large end of the notch bar. The latter is thus thrust lightly endwise so that contact is maintained between the small end, the length bars, the balls and the pin in the support bar. For loading the workpiece, the carriage and sensing finger are withdrawn, and they are now advanced to engage the finger with the left-hand side face of the notch nearest to the small end of the bar. Any deviation of the indicator pointer from the zero position is noted, and the carriage is then withdrawn.

For checking the position of the next notch (No. 2), the 5-in. bar and the ½-in. balls are retained in position, and the 4-in. bar is replaced by one of 3-in. length. The workpiece is moved into contact with the new length bar, and the block *W* is reset to hold the component, bars and balls in contact, before the carriage and sensing finger are again advanced and the indicator read. The sequence is repeated, using the 5-in. bar and ½-in. balls with progressively shorter bars down to 1-in. long, to check the third and fourth notch. For the fifth and sixth notches, respectively, the 1-in. bar is retained, and the 5-in. bar is replaced by a 4-in. bar (as seen at *V*, Fig. 4) and a 3-in. bar.

The mechanisms of "Monotype" casting machines and the "Monophoto" Filmsetters incorporate pairs of conjugate cams. For example, there are eight pairs of cams and one single cam on the Filmsetter and Composition Caster machines, and some 20 different types of cams are made by the company.

MILLING CONJUGATE CAMS

Cams used on "Monotype" machines are produced from castings in Meehanite iron, and all other machining operations are completed before the profiles are cut. A typical pair of cams, as used on the Filmsetter machine, is shown in Fig. 5. Each pair consists of a master and a follower, and the cams are identified by raised reference numbers or letters in cast-in recesses. To distinguish between the cams of each pair, the recess in the master cam is of rectangular form, whereas that in the follower is circular. The cams operate in conjunction with a follower-roller, of 1·500 in. diameter, mounted on the end of a lever, and levers of different lengths are employed for the various types of mechanism. Maximum permissible play between the follower-roller and the pair of cams is specified, and is generally 0·005 in., as in the example shown. For two cams on the Filmsetter machine, however, the maximum play is 0·002 in., and with certain other cams, up to 0·010-in. of play

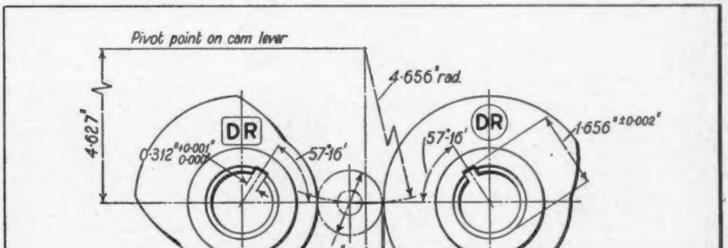


Fig. 5. This pair of cams, used on the "Monophoto" Filmsetter, is typical of those that must be profile-milled to close limits at the Monotype Works

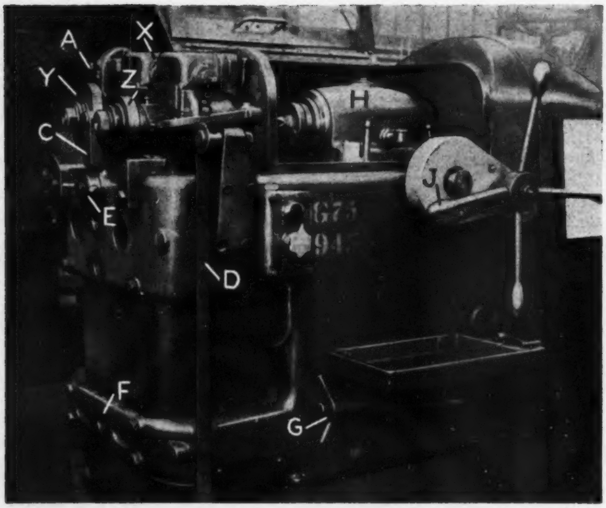


Fig. 6. This 2-spindle machine has been designed and built by the Monotype Corporation for profile milling conjugate cams. The complete work-head is arranged to rock about one of a number of pivot points, which is selected to duplicate the service conditions for the cams

is permissible over the "rise" portions of the profiles.

Reference was made to the production of cams in an earlier article in MACHINERY,* and it may be mentioned that each blank is bored, one side of the cam portion is faced, and the boss on one side is turned, faced and chamfered, on a capstan lathe. The other side of the cam portion is then faced, and the other boss is turned, faced and chamfered, after which the keyway is broached. Pairs of blanks are stamped with the same serial number, and are then ready for profile milling.

Pairs of blanks are milled simultaneously on the machine shown in Fig. 6, which has been developed by the Monotype Corporation, Ltd., The work-head assembly *X* incorporates two spindles, mounted in plain bearings, at the outer ends of which are carried hardened steel cams *Y* and *Z*. Each cam is keyed to the associated spindle, and is retained by a nut and washer. The profiles of the steel cams correspond to the forms required on the two cams to be milled, which are mounted on the inner ends of the spindles. Each spindle is driven by worm gearing, and the common worm shaft is itself driven by worm and wheel. The latter worm is of the drop type, and is held in engagement with the wheel by a latch *A* on the enclosing cover. When the worm drive is disengaged, the spindles can be driven by means of a hand crank, which is fitted to the square end *B* of the common worm shaft.

On the machine base, between the two cams *Y* and *Z*, is mounted a bracket *C*, which carries a 1·500-in. diameter roller, made from steel and hardened and ground. This roller is of the same diameter as the follower roller with which the two cams to be cut will be used. The complete work-head assembly is arranged to pivot, and is urged in an anti-clockwise direction (as viewed from the left-hand end of the machine) by the action of a weight which is attached to the strap *D*. In order to duplicate the operating conditions for the various machines with which the different pairs of cams are used, the pivot point for the work-head assembly can be varied. The assembly pivots about a steel shaft, the enlarged end of which is indicated at *E*. This shaft may be inserted in any of four holes in the outer wall and an interior wall of the machine base, the lowermost hole being indicated at *F*. There are corresponding holes in the work-head assembly, and a spare shaft, as at *G*, is provided, which is inserted in a new pivot position before the shaft in the previously-used position is removed. When a shaft has been inserted, it can be locked in position by sliding pads, which are urged radially to engage the surface of one of the pivot holes, by turning the knurled knob at the end.

The cutter head of the machine is indicated at *H*, and it has a large-diameter spindle mounted in Timken taper-roller bearings. Supported on dovetail guideways, the cutter head can be traversed towards and away from the work-head assembly by rack and pinion, connected by reduction gearing to the starwheel *J*. The axis of the head is aligned with that of the roller on the bracket *C*, and when the head has been advanced to the cutting position, it can be locked by two lever-screws, which apply pressure to the gib strip.

Drive to the machine is taken from a 1-h.p. motor in the base, and the motor pulley is connected by three V-belts to a countershaft. On this shaft there is a multi-groove pulley, and a 2-step flat pulley. Drive is transmitted by three V-belts from the grooved pulley to a pulley

* MACHINERY, 80/795—8/5/52.

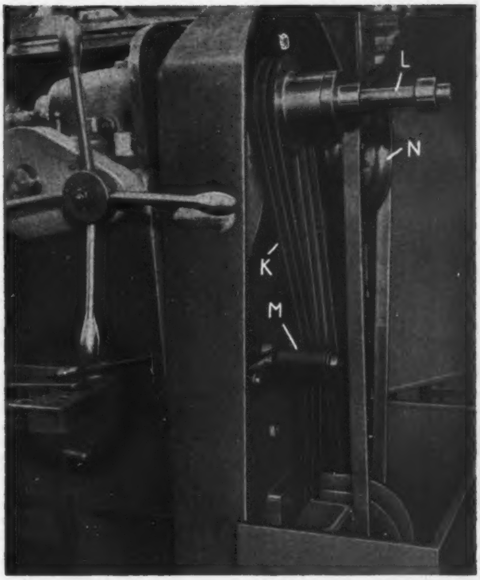


Fig. 7. Close-up view of the drive arrangements for the cutter head and the telescopic universal shaft connected to the work-head on the cam profiling machine

co-axial with the cutter spindle, and these belts may be seen at *K* in Fig. 7. The driven pulley is supported independently of the cutter spindle, an extension of which slides through the bore, as seen at *L*. Drive to the spindle extension is transmitted by a key, and a collar on the extension controls the axial movement of the spindle towards the work. Tension is maintained on the V-belts by a plain jockey pulley *M*, which contacts the outer surface of the belts, and the arrangement is such that the cutter spindle is driven at 600 r.p.m.

A flat belt connects the 2-step pulley on the countershaft with a similar pulley *N*, which is mounted at one end of a universal-jointed, telescopic shaft coupled to the drop-worm of the work-head assembly. The end of this shaft adjacent to the work-head may be seen at *P* in the close-up view, Fig. 8, and the universal joints allow for the swinging motion of the head. Two work-speeds are provided by the stepped pulleys, and the cams shown are cut at the slower speed of 1 rev. in 3 min. 40 sec. At the higher speed, 1 rev. is completed in 2 min. 45 sec.

In Fig. 8, the two cam blanks to be profile-milled may be clearly seen. Swarf produced during the milling operation falls through an opening in the machine base on to a chute, whereby it is directed into a container at the left-hand end of the machine. The cutting zone of the machine is normally enclosed by hinged guards during milling, and these guards have been swung clear in Fig. 6 and 8. In order to remove the very fine swarf produced during milling, the rear guard has an outlet connection to an exhaust system.

MILLING CUTTER WITH HELICAL CARBIDE TEETH

For profile milling, the Monotype Corporation use cutters with helical, inserted, tungsten carbide teeth, as seen at *R* in Fig. 8, and these cutters are made in the toolroom at the Salfords works. During work-loading and other non-cutting stages, the

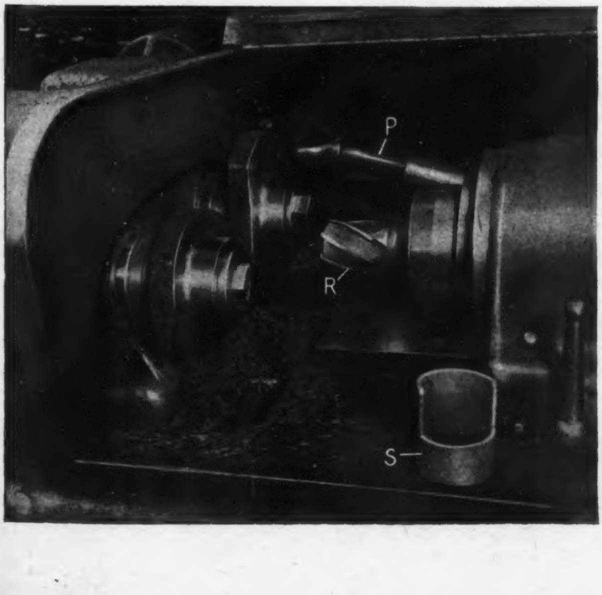


Fig. 8. On the "Monotype" machine, both cams of a conjugate pair are machined simultaneously with a cutter that has helical inserted carbide teeth

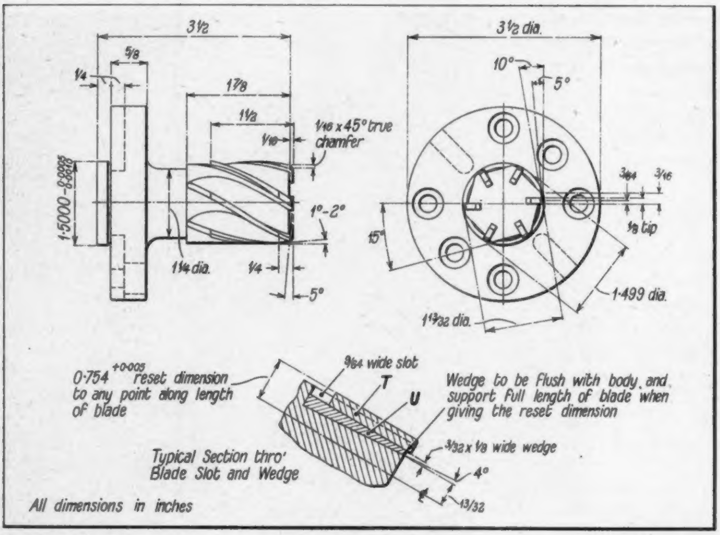


Fig. 9. Details of the cutter employed for cam milling. Attention is drawn to the robust design of the cutter body, and the provisions for resetting the teeth when a wear allowance has been exceeded

cutter is enclosed by an aluminium cover S, to protect both the cutting edges and the operator.

Details of the cutter are given in Fig. 9, and it will be seen that it has six teeth, of 30 deg. helix angle, right hand, and is arranged for left-hand cutting. Attention may be drawn to the relatively massive proportions of the cutter body and the method of flange mounting to ensure maximum support and rigidity, drive being transmitted by two keys. The inserted blades, as at *T*, are of Prolite 21A grade tungsten carbide, and are supplied formed to a 30 deg. helix. Each blade measures 1⅞ in. long, ⅛ in. wide and ¼ in. deep, and is supported on a wedge, as at *U*, in a helical slot milled in the cutter body. This arrangement has been adopted to allow the blades to be re-adjusted when the diameter over the cutting edges has been reduced by wear to 1·496 in. Prior to brazing, the blades and slots are thoroughly cleaned, and the blades are set to the 0·754 in., −0, +0·005 in. dimension, by means of the wedges, and are wired in position in the toolroom. When the cutter is serviced, the $\frac{1}{16}$ in. by 45 deg. chamfer on the end of each blade is reground.

During milling of the cam form, the depth of metal removed is ⅛ to $\frac{5}{32}$ in., and the metal removal rate is 0·7 to 0·8 cu. in. per min. Cams with steep rises are rough and finish milled, 0·010 to 0·015 in. of metal (radially) being removed at the finishing operation. A complete batch of cams is first rough milled, and the cutter is then changed for finish milling. Other cams are milled in one stage, and it is intended, eventually, to adopt this method for all cams. It is usual to machine 300 pairs of cams with each cutter before it requires to be reground.

CAM CHECKING FIXTURE

After the profile milling operation, the forms of the cams in each pair are checked on the fixture seen in Fig. 10. The fixture is so designed that the arrangement of the cams and the follower roller *V* is the same as in the assembled Film-

Fig. 10. This fixture is used for checking the profiles of the cams after the conjugate profiles have been milled

setter or casting machine. Two spindles, whereon the cams are mounted, are carried in bearings in the cast-iron base of the fixture, and are connected by gears. These gears are identical to those fitted to the machine on which the cams will be used, and both spindles can be rotated in phase by means of the handwheel W.

The hardened and ground follower roller, which is of 1·500 in. diameter, is mounted on the end of a lever X. There are four bushed holes in the lever, and corresponding bushed holes in the fixture base, and a pivot pin Y is inserted in these holes to provide pivoting conditions identical with those on the machine to which the cams will be fitted. A pair of cams to be checked is rotated, using the handwheel W, and should run freely and smoothly together, but should not permit the insertion, between the profile and the roller, of a feeler corresponding to the maximum clearance specified on the part drawing.

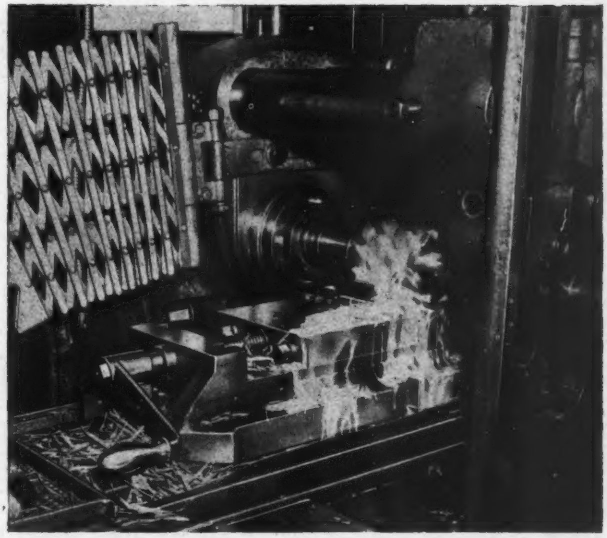


Fig. 11. (above) A Brown & Sharpe No. 12 machine set up for cutting a step in an En.8 workpiece with a high-rake slab mill

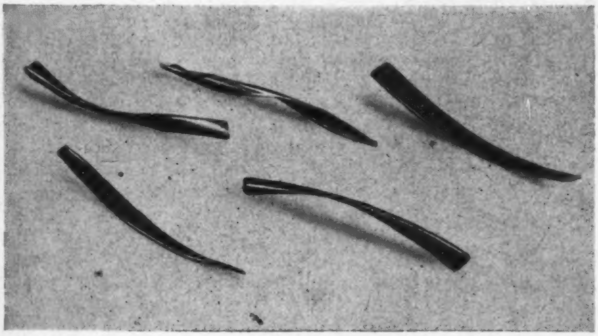
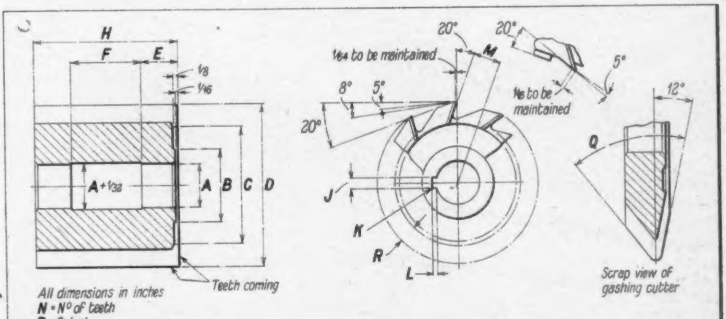


Fig. 12. (left) Chips produced at the high-rake slab milling set-up seen in Fig. 11. The shape of the chips is indicative of an efficient shearing action



Cutter	A	B	C	D	E	F	H	J	K	L	M	N	P	Q	R
X	1¼ dia	2 dia	2½ dia	3½ dia	1	2	4	5/16	3/64 rad	1/8	0·598	9	35° L.H. Spiral	12°+38° 3/32 rad	7/16
Y	1¼ dia	2 dia	3¼ dia	4½ dia	1	2	4	5/16	3/64 rad	1/8	0·769	10	35° L.H. Spiral	12°+38° 3/32 rad	1/2

Fig. 13. (below) Details of the high-rake slab mills used by the Monotype Corporation, Ltd., also of the gashing cutter used for machining the teeth in the high-speed steel cutter blanks

HIGH-RAKE SLAB MILLING

The Monotype Corporation has carried out extensive research into high-rake milling, and, as discussed in an earlier article,* has derived considerable advantages

* MACHINERY, 80/707—24/4/52.

from the application of this method to production operations. More recently, the company has extended the use of high-rake cutters to slab milling, and Fig. 11 shows the machining of a broad, deep step in a component known as a large side block. The workpiece is made from En. 32B casehardening steel, and is of rectangular form. It is required to machine a step with a cross-section measuring $1\frac{3}{4}$ in. wide by $\frac{3}{4}$ in. deep across the full $\frac{7}{16}$-in. width of the component.

This step is milled at one pass on a Brown & Sharpe No. 12 machine, with the work held in a Brown & Sharpe No. 3 machine vice. The work blank is loaded so that the broad side faces are engaged by the jaws, with one edge resting on a support, and is located endwise by a stop. Conventional or up-cut milling is employed, at a table feed rate of $5\frac{3}{8}$ in. per min., and a cutter speed of 175 r.p.m. The time that elapses from the end of the rapid approach traverse to the start of the rapid return traverse is 25 sec., and during this time 0·574 cu. in. of metal is removed. Attention may be drawn to the well-sheared swarf produced by the high-rake slab milling cutter, and a close-up view of a number of typical chips is given in Fig. 12.

High-rake slab mills have been standardized by the Monotype Corporation, and part of a drawing giving details of such cutters is shown in Fig. 13.

Fig. 15. The set-up for high-rake slab milling blanks for type clamps on a Brown & Sharpe No. 12 horizontal machine. Climb milling is employed

The cutter for the operation described above is indicated by *X* in the table, and it will be noted that details of the gashing cutter for producing the teeth are also given. High-rake slab mills are made from high-speed steel, and are of two types, one with teeth at the right-hand end, as shown, and the other with teeth at the left-hand end.

The cutter indicated at *Y*, Fig. 13, is used for slab milling a component known as a type clamp. Made from En. 32B casehardening steel, the blanks for the production of type clamps are first rough machined to obtain blocks measuring $3\frac{11}{16}$ in. long, by $1\frac{1}{16}$ by $\frac{13}{16}$, and are then ground on the top, bottom and side faces on a Churchill machine. A blank at the end of this stage is seen at the right in Fig. 14.

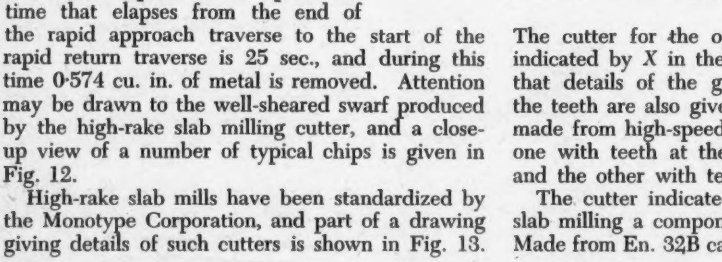


Fig. 14. A type clamp is seen at the left after the slab milling operation, and a blank at the right. In the foreground are some samples of the swarf produced by the high-rake cutter

For slab milling, blanks are transferred to a Brown & Sharpe No. 12 horizontal production milling machine, and a general view of the set-up is given in Fig. 15. Blanks are milled one at a time, and are held in

special jaws fitted to a Brown & Sharpe No. 3 machine vice. One jaw incorporates a peg, which provides for endwise location. During milling, a copious flow of soluble oil coolant is directed on to the cutter and the workpiece by way of a fish-tail nozzle.

Climb milling is employed for the type clamps, and the cutter is run at 95 r.p.m. There are provisions for changing the feed rate during cutting on the Brown & Sharpe machine, by means of trip dogs in slots at the rear of the table. For the first minute of the actual cutting period—that is until the cutter is fully engaged with the workpiece—the feed rate is 1¼ in. per min., and this rate is doubled for the remainder of the cutting traverse. The total cutting time is 1½ min.

A workpiece is seen at the left in Fig. 14, and it will be observed that the slab milled surface has an excellent finish, and that there are practically no burrs. Evidence of the efficient shearing action of the high-rake cutter is afforded by the tightly rolled swarf, seen in the foreground in Fig. 14. Usually 250 components are milled before the cutter is reground. It is the company's practice to specify the number of parts to be milled between cutter sharpening operations. This number is based on trials, and it has been found that if the optimum value is exceeded, the wear of the teeth increases disproportionately, and an excessive amount of material must be removed to restore the cutter to the original condition. Cutters are usually made to Monotype design by any of a number of suppliers.

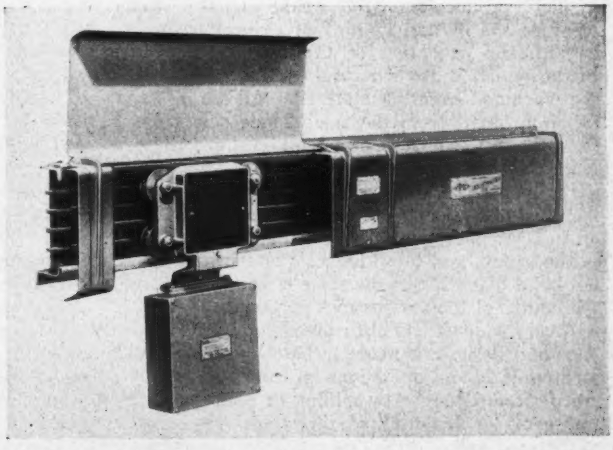
A further article devoted to the practice at the works of the Monotype Corporation, Ltd., will be published shortly in MACHINERY.

E.M.S. Trolleymaster 250 Electrical Current Supply System

E.M.S. Electrical Products, Ltd., Common Lane, Kenilworth, Warwickshire, have recently introduced the Trolleymaster 250 system, for supplying electrical power to mobile equipment such as overhead cranes. The conductor bars are suitable for 250 amp. a.c. or d.c. at voltages up to 600, and the 4-bar type, which is available at present, provides for carrying a 3-phase supply with earthing. The design is generally similar to that of the company's Trolleymaster 100 system, but particular attention has been paid to ease of erection and accessibility for maintenance, and one of the hinged cover plates on a typical section is seen raised in the figure.

A cast, non-ferrous, collector trolley body is provided with upper and lower pairs of 3-in. diameter grooved rollers, which are mounted on shielded ball bearings and engage tracks on the conductor housing, which is made from ⅛-in. thick mild steel sheet. There is provision for towing the trolley by means of a chain, and the upper rollers can be readily disengaged from the associated track, to enable the unit to be removed at any position. Spring-loaded copper carbon pick-up brushes are employed, which are rated at 50/60 amp. each, and can be arranged singly or in multiples, for loadings up to 150 amp. The brushes are connected to the terminal box attached to the bottom of the body by means of insulated copper braid.

Of drawn, high-conductivity copper, the conductor bars are a sliding fit in the moulded Rosite insulators, which are located by cast, non-ferrous internal brackets and clamped by removable straps. With cross-sectional dimensions of 11¼ by 7 in., the conductor assembly is supplied in 10-ft. lengths, and weighs 12 to 14 lb. per ft.



This E.M.S. Trolleymaster conductor assembly, for supplying current to mobile equipment, incorporates four bars, with a capacity of 250 amp.

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The A.E.I. Blading Works at Larne

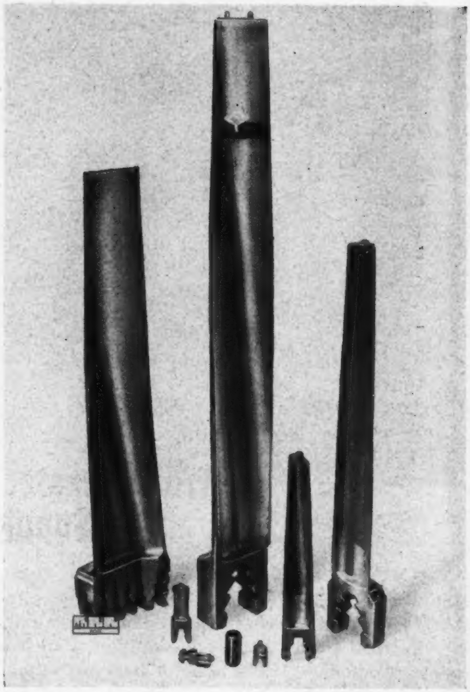
Some Examples of Machines and Equipment Employed for the Production of Turbine Blades in Batch Quantities

By A. W. ASTROP, Associate Editor

THE A.E.I. FACTORY at Larne, Northern Ireland, is the second largest of the four which are maintained for the production of turbine-generators and heat-exchangers, being exceeded in floor area only by the works at Trafford Park, Manchester. An article in MACHINERY, 98/1343—14/6/61, described some of the machines and set-ups in the heavy-machining area of the main building at Larne, which has a floor-area of 366,000 sq. ft. and affords space and facilities for erecting turbines up to the largest size anticipated in the future. Adjacent to the heavy-machining and erection section there is a smaller building, of 65,000 sq. ft., which is equipped with a wide variety of standard and special production machines and provides all the blades required for the turbines. A representative selection of turbine blades is shown in the heading illustration, including the largest and the smallest produced in the blade factory, which measure 39¾ in. and 1¾ in. long respectively.

With the exception of the extreme left-hand blade, which is from a forging, the items shown are machined from bar material. All are of stainless iron, apart from the small blade seen second from the left, which is in a high-tensile steel, and is for the first stage of the high-pressure section of a turbine. A cylindrical 2-in. length standard is included at the centre of the front row, to provide an indication of the heights of the various blades in the group, and the 3-in. scale at the foot of the left-hand blade serves the same purpose as regards the widths of the various root portions.

A very wide variety of turbine blades, of different sizes and designs, is made in batches of small and medium size, and operations on the blade portions are performed either by milling or planing, in the transverse or longitudinal directions. A number of different makes of milling machines is employed, of both standard and special types, and some typical examples are here discussed.



SPECIAL HOLROYD 4-STATION BLADE MILLER

One of the largest special-purpose machines installed in the blade factory was designed and built by John Holroyd & Co., Ltd., Rochdale, Lancs., and is shown in Fig. 1 This machine has four working stations, two at one side being arranged back to back with two at the other side, and a different type and size of blade can be milled at each station, if required. Alternatively, all stations can be set up for operations on four identical blades. The machine operates on the direct-copying principle, and a roller, which is in contact with a continuously rotating master blade, is carried at the free end of the large cast arm *A*, which also houses the cutter spindle. This arm is pivoted at the lower end, about a horizontal axis, and the arrangement can be seen more clearly in the close-up view Fig. 2, where the arm is similarly lettered and the pivot point is indicated at *B*. In this view, the master form is shown at *C* and the workpiece at *D*, and the size ratio between the two is 3 to 1.

The workpiece machined at this set-up is an aluminium/bronze blade for a compressor, and it is rotated in synchronism with the master at 15

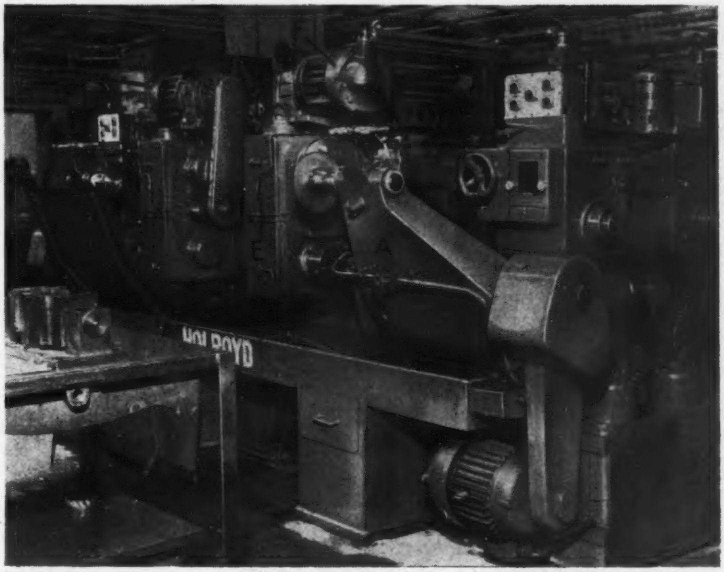


Fig. 1. This Holroyd special-purpose blade milling machine has four working stations, which may be set-up independently, for operations on different blades, if required.

r.p.m. Workpiece and master are held in special chuck-type fixtures on the ends of parallel spindles within the housing *E*, Fig. 1 and 2, and these spindles are driven through belts, and spur gearing, by the motor *F*, Fig. 1. The housing *E* is arranged to slide horizontally on ways on a vertical wall, extending upwards from the base, and there are similar ways on the other side of the wall, for the working station which is back-to-back with that illustrated.

Referring to Fig. 2, it will be appreciated that the centre distance of the pivot *B* and the cutter *G* is one-third that of the pivot *B* and the follower roller, and that the master form *C* is three times as large as the finished workpiece. At the upper end of the pivoting arm *A* there is a cast iron bracket which serves as an anchor point for the piston rods of air cylinders, as at *H*. When air is admitted to the rod ends of these cylinders, the arm *A* is swung in a direction away from the camera, until the follower roller makes contact with the master form. Contact between these two members is maintained, under the pressure of the cylinders *H*, while the housing *E* is fed to the right. As a result, the follower and cutter traverse the full length of the master and workpiece, and since the latter is rotating in synchronism with the former the complete blade portion is machined.

If roughing and finishing cuts are required, a follower of slightly larger diameter is employed for the first cut, which has the effect of holding-off the cutter by the required amount. Subsequently, a second cut is made with

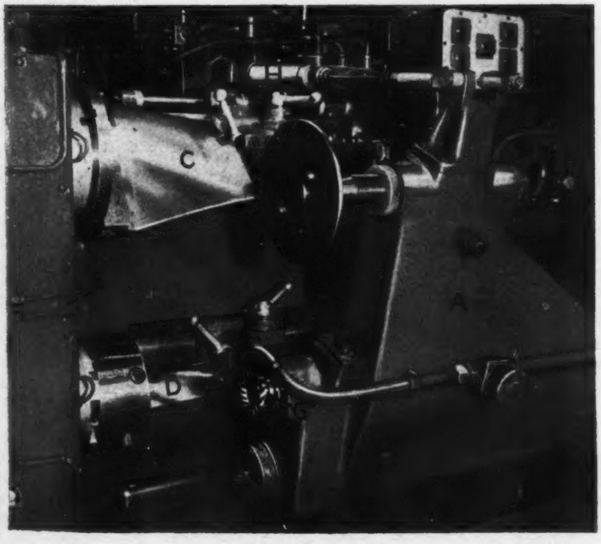


Fig. 2. Close-up view of the working area of one station on the Holroyd machine shown in Fig. 1

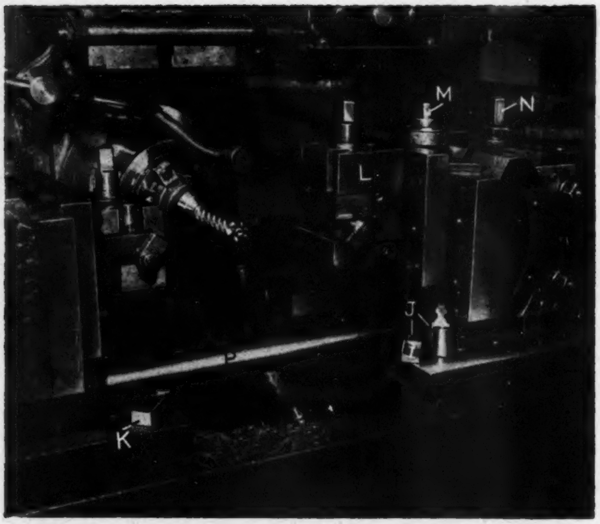


Fig. 3. The concave surfaces of two blades are plunge-milled simultaneously on this Sundstrand machine

a reduced-diameter roller. To facilitate removal of the work, the air supply to the cylinders *H* is reversed, to move the arm *A* towards the camera. This movement continues for the full stroke of the air cylinders, and the roller and cutter are thus held well clear. The 2½-in. diameter cutter seen in Fig. 2 is of high-speed steel, and for machining the compressor blade shown it is driven at a speed of 265 r.p.m. while the housing *E* is advanced at a feed rate of ⅜ in. per min.

The three remaining working stations of this machine are identical with that just described, and each is independent and is served by five electric motors. One motor, as at *F* in Fig. 1, drives the master and the workpiece, and there are separate motors for the cutter spindle, the feed motion, the rapid traverse motion, and the coolant pump.

SUNDSTRAND PLUNGE-MILLING MACHINE

For some types of blades, a truly arcuate concave form is required on one side, and when the overall length of the blade permits, this operation is carried out on a Sundstrand horizontal plunge-milling machine (Rockwell Machine Tool Co., Ltd.). A typical set-up is shown in Fig. 3, where two plunge-milled blades are seen at *J*, and a blank at *K*. The latter, it may be noted, has been sawn from bar stock, and machined at the root end. The Sundstrand machine has a T-shaped bed, in plan, the leg of the T serving to support the cutter head and the cross-bar portion providing slideways for two opposed work-heads, seen at the right and left in the figure. On the inner end of each work-head there is a heavy-duty, screw-operated, vice-type fixture, as at *L*, which will accommodate interchangeable jaws and locating members, to suit various types of blade blanks.

The fixture *L* is mounted on the front face of a dovetail slide, which can be adjusted vertically in ways in the work-head, by means of the square-ended screw *M*, in order to set the blank at the required height relative to the cutter. Of arcuate form, the rear face of the dovetail slide mates with a seating of similar shape in the main casting of the work-head, and can be swivelled about a horizontal axis through an angle of 30 deg. above and below the zero position. This movement is effected by means of the square-ended screw *N*, which is integral with a worm that meshes with teeth cut in the rear face of the dovetail slide, and is employed to set the machine for producing a tangential outlet flat on the arcuate form of the blade. The required angular setting is made with reference to a scale and vernier.

A third adjustment provides for moving the complete work-head transversely, and is employed to align the two units with each other. The cutter spindle is carried in a quill, which can be adjusted axially for setting the position of the cutter in relation to the blanks. In Fig. 3, the work-heads are shown in the loading position, and fresh blanks have been inserted and clamped in the vices. The machine cycle is automatic and is started by pressing a push-button, whereupon the work-heads advance rapidly towards each other. At a predetermined point, the rapid advance is stopped, the feed rate is engaged, and the work-heads close on to the cutter. This movement is continued until the blanks have been plunge-milled to a predetermined depth, when the heads are rapidly withdrawn.

The heads are advanced and withdrawn by a twin eccentric and connecting rod mechanism, which is driven by a reversible electric motor at the left-hand end of the machine bed. There is an eccentric beneath each work-head, at the outer end, supported with its axis vertical in bearings in the bed. One end of a plain connecting rod is pivoted on this eccentric, and the other end is pivoted on the under-side of the work-head. Rotation of the

eccentric in one direction serves to advance the work-head towards the cutter, and rotation in the reverse direction withdraws it. A positive drive connection between the two eccentrics is provided by the shaft *P*, which ensures synchronism.

The various functions of the machine cycle, for example, directional control of the motor driving the eccentrics, and engagement of the feed motion and rapid return, are initiated by trip dogs, which are angularly adjustable on the periphery of a drum housed at one end of the machine, and driven, through reduction gearing, from the motor mentioned above. The cutter seen in Fig. 3 is 1·10 in. diameter by approximately 3 in. long, and is of high-speed steel. On the Sundstrand machines, blades up to approximately 8 in. long are plunge-milled, two at a time, with a cutter of about 3 in. diameter. For such operations, the overarm seen at the top in Fig. 3 can be brought into use to support the outer end of the cutter arbor. It will be appreciated that owing to the balanced cutting action, cutter deflection is eliminated, and high metal removal rates can be obtained.

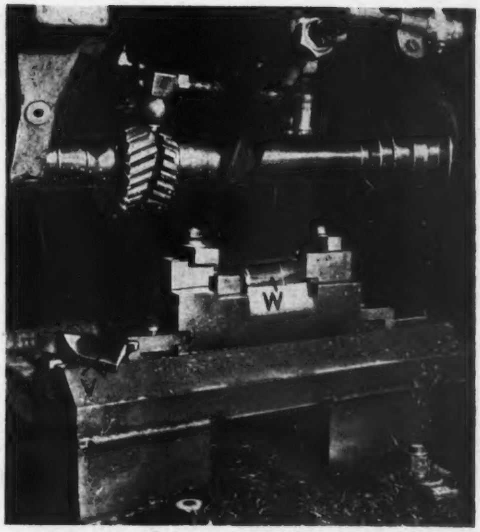


Fig. 5. Close-up view of the working area of the Heller machine shown in Fig. 4. The Brayshaw cutter has two banks of teeth of opposite hand, separated by a staggered relief

HELLER HORIZONTAL COPY-MILLING MACHINE

For producing the convex surfaces on some types of blades, Heller horizontal copy-milling machines (Wickman, Ltd.) are employed, and a general view of a typical set-up on a type FH 120-2 machine (with guards removed) is shown in Fig. 4. The rise and fall motion of the knee is controlled by an electronic copying unit which operates in conjunction with a flat template secured to the rear face of the work-table. This template is indicated at *R* in Fig. 4, and it is carried on a slide which is arranged for longitudinal adjustment, to facilitate setting relative to the workpiece.

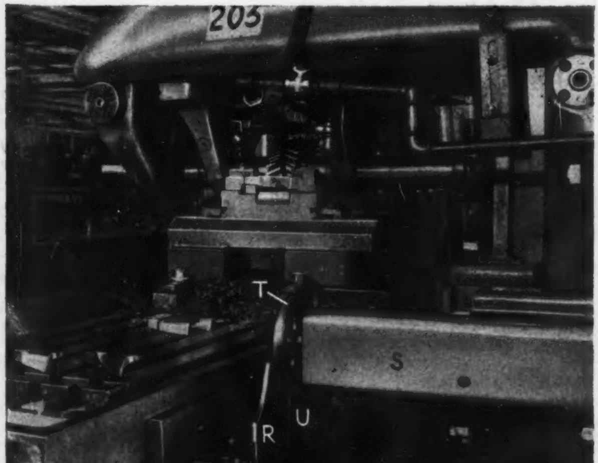


Fig. 4. Set-up for transverse copy-milling blades on a Heller horizontal machine. The template and electrically-operated copying stylus can be seen in the foreground

The stylus unit is housed within the casting *S*, which is supported from the main column of the machine and has vertical and transverse adjustments for setting the stylus spindle in relation to the template. On the end of the stylus spindle there is a light-alloy wheel, as at *T*, and a number of these wheels, of different diameters, is provided, since the wheel for any given set-up must be of the same diameter as the cutter.

In Fig. 4, can be seen a plain tem-

plate U, just behind the main template R. The stylus wheel is resting on this template, which serves to control the vertical position of the knee as the table is traversed longitudinally to bring the work to the cutter. Subsequently, the template R comes in contact with the stylus wheel, and deflects it, and a signal is thus transmitted to the elevating drive for the knee. During continued longitudinal motion of the table, the stylus wheel rolls round the periphery of the template, and the cutter thus makes a complete pass over the work.

A close-up view of the work-holding fixture and cutter employed at this set-up is shown in Fig. 5, where a blank blade, in the condition in which it is received at the machine, is indicated at V. It will be noted that the root end has already been partly machined, that there is a small pip protruding from the tip end, and that part of the metal on the convex side has been machined away to form a wide chamfer. The concave side has already been finished machined, and the fixture incorporates a cast block as at W, which fits the under-side of the blade and provides effective support against the cutting thrust.

In the fixture, the blade is located transversely at the root end, also at the tip by fingers which engage with the sides of the projecting pip. Longitudinally, it is positioned by shoulders which engage with faces at the root end. The two plain clamps at the top of the fixture serve to thrust the blade downwards, into contact with the cast block indicated at W.

The cutter seen in Fig. 5 is of high-speed steel and was supplied by Brayshaw Tools, Ltd., Manchester. Of the side and face type, it is 5½ in. diameter and has two banks of teeth, of opposite hand, with a staggered relief between them. The amplitude of the stagger is greater than the width of the relief, and with this arrangement an overlapping cut is ensured.

The blade in question is of stainless iron, and at the set-up in Fig. 5 the convex surface and one side of the root portion are milled in one pass, at a feed rate of 5 in. per min., and a cutter speed of 56 r.p.m.

In a second article concerned with the practice at the blading works at A.E.I., Ltd., Larne, some other operations will be considered, including copy-milling blades longitudinally on a modified Rockford openside planing machine, copy-planing blades transversely on a Rockford machine, and copy-milling long blades on a Swiss Rigid horizontal machine.

Grinding Rubber Rollers

CENTRELESS GRINDING of cylindrical rubber components, for example, rollers for washing machines and typewriters, often presents problems on account of the elasticity of the material, but these difficulties are stated to have been overcome by means of an arrangement developed by Arthur Scrivener, Ltd., Tyburn Road, Birmingham, 24. In Fig. 1 is shown a general view of the company's No. 3 centreless grinding machine which has been modified to provide for grinding the peripheries and flanges of rubber pump liners of the type seen standing in the right foreground. This machine, which has

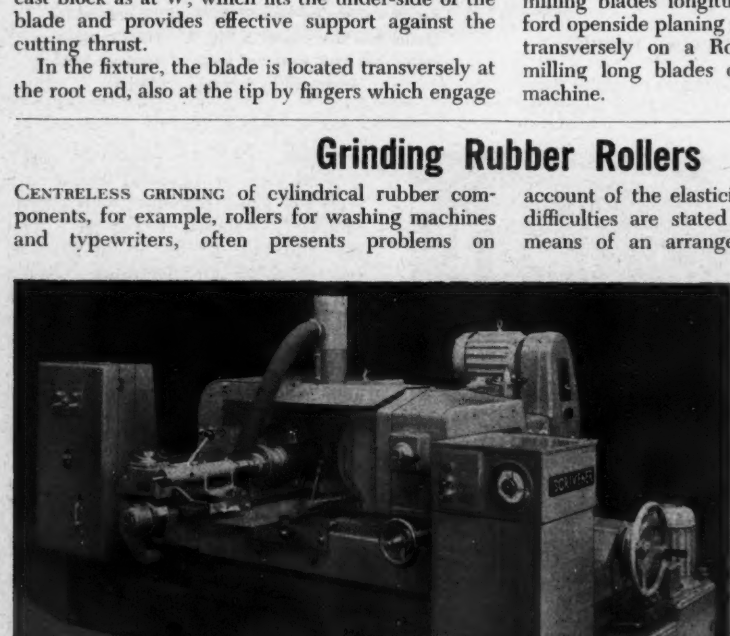


Fig. 1. Scrivener No. 9 centreless grinding machine modified to provide for operations on cylindrical rubber components of the type seen in the right foreground

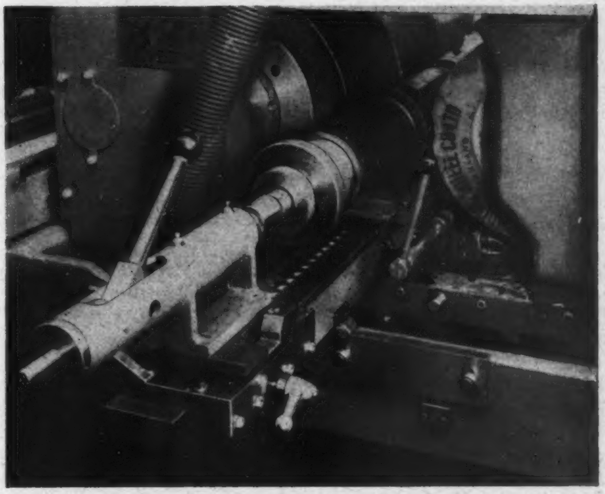


Fig. 2. Close-up view of the working area of the machine in Fig. 1. A rubber pump liner is here seen in position on a mandrel which is held between the centres of a special fixture

a 20-in. diameter by 10-in. wide grinding wheel, and a 12-in. diameter by 10-in. wide control wheel, is powered by a 20-h.p. motor. The largest liner in the group in Fig. 1 is 6 in. diameter by 22 in. long, and stock removal up to a maximum of 0·060 in. is required.

With the new arrangement, the rubber liner is placed on a mandrel, and the latter is supported between centres in a special fixture which takes the place of the conventional work-rest provided on a standard machine. A close-up view of the working area of the machine is given in Fig. 2, where the special fixture can be seen, with a rubber roller in position on a mandrel in readiness for grinding. The fixture incorporates a tailstock, seen in the foreground, which can be adjusted longitudinally as a complete unit to accommodate mandrels of different lengths. Axial movement of the tailstock quill, to provide for loading and unloading the work, is effected by the lever seen projecting from the top of the unit.

Each rubber liner is ground in three stages—one for each of the cylindrical portions at the sides of the central flange, and one for the flange periphery. The work is ground dry, and efficient dust extraction equipment is provided. A fully-automatic working cycle provides for advance of the control wheel, a dwell period, and rapid withdrawal of the control wheel at the end of the operation. The length of the dwell period can be pre-set by means of an electrical timer, the dial of which is seen on the control cabinet at the right in Fig. 1.

EXPORTS OF MACHINERY, other than electric, during the first four months of this year reached a total value of £282,496,715, which was an increase of £35,576,556 on the total for the same period in 1960. Principal markets in the period up to April 30, 1961, were: Australia (£19,629,592); Canada (£17,363,391); U.S.A. (£16,972,107); India (£15,501,033); and the Union of South Africa (£13,270,046).

Production of Fan Casings on a Leifeld Electro-hydraulic Spinning Lathe

Metal Spinners (Newcastle), Ltd., Dunn Street, Newcastle-upon-Tyne, 4, have installed a German-built Leifeld electro-hydraulic spinning lathe, which, in addition to enabling thicker materials to be handled, has permitted considerable increases in production, in some instances in the ratio of ten to one.

One application is concerned with the production, from ¼-in. thick mild steel plate, of a large quantity of fan casings, of approximately 30 in. diameter by 12 in. deep. This casing is in the form of two truncated cones joined together at their smaller diameters. One cone has a larger major diameter than the other, also it incorporates a 3-in. wide flange. With the original method of manufacture, each cone was cut from sheet, rolled, and then welded at the seam. The small diameter ends were next welded together, and the flange—cut from sheet—was welded to the rim of the casing.

To produce the casing by metal spinning, the conventional procedure would be to spin the larger cone complete with its flange, and the smaller cone, separately, and to weld the two units together. On the Leifeld lathe, the fan casing is spun in a single operation over a chuck of 2-piece construction, spigoted at the smallest diameter, to enable it to be removed from the workpiece.

The sole agents in this country for Leifeld spinning lathes are the Embassy Machine & Tool Co., Ltd., 248 Watford Way, London, N.W.4.

Magnetic Journal Bearings

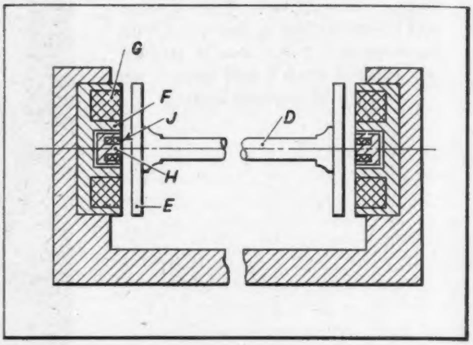


Fig. 2. The shaft *D* is supported on magnetic bearings (not shown) of the type seen in Fig. 1, and is stabilized axially by a pair of co-axial electromagnetic bearings, at each end

AN ARTICLE* in a recent issue of *Philips Technical Review* is concerned with the design of magnetic journal bearings, in which the shafts are supported in magnetic fields and there is no material contact. Contributed by Mr. F. T. Backers, the article includes a description of the bearing shown diagrammatically in Fig. 1. On the shaft *A* there is a number of magnetic rings, as at *B*, which are made from a ceramic permanent-magnet material known as Ferroxdure I and are magnetized radially. It will be noted that adjacent rings have opposite polarity, and although four rings only are shown in the diagram, in practice a much larger number would be employed. A similar set of radially-magnetized rings is located on the shaft at a known distance from the first set, to provide two separate bearing portions.

Each set of rings on the shaft is surrounded by larger, radially-magnetized rings, in a bearing housing as at *C*. The larger rings also have alternate opposite polarity. With this arrangement, the rings on the shaft *A* are supported in the fields of the rings in the bearing housings *C*, and the selected polarities ensure that radial equilibrium is maintained. For example, if an external radial force is applied to the shaft *A*, the concentricity of the rings *B* to the housings *C* is disturbed. The magnetic force at the points where the rings are closest is always larger than that existing at the diametrically opposed points. Since each ring on the shaft is of opposite polarity to the corresponding ring in the housing, the resultant forces tend always to return the shaft to the concentric position. If opposing rings were of similar polarity, equilibrium would be possible but would be unstable.

In the axial direction, however, the shaft is not stable, since any axial deflection of the shaft will tend to be increased by the magnetic fields of the bearings. This difficulty can be overcome by providing a fixed thrust pad at one end of the shaft, but if it is desired to avoid rubbing contact, further magnets—of the electro-magnetic type—can be provided, one at each end of the shaft. Such an arrangement is shown in Fig. 2, where the radial bearings for the shaft *D*, of the type shown in Fig. 1, have been omitted for clarity. At each end of the shaft there is a disc, as at *E*, of ferrox-cube material. An electro-magnet *F* is excited by a coil G, and is arranged co-axially with another electro-magnet *H* which is excited by a coil *J*. An exactly similar arrangement of electro-magnets and coils is provided at the other end of the shaft.

The self-inductance of the coil *J* decreases as the distance between its outer face and that of the disc *E* increases, so that with an appropriate

* A Magnetic Journal Bearing, F. T. Backers, Philips Technical Review, No. 7, Vol. 22, 1960/61.

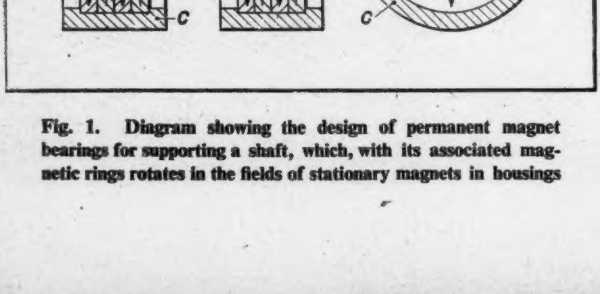


Fig. 1. Diagram showing the design of permanent magnet bearings for supporting a shaft, which, with its associated magnetic rings rotates in the fields of stationary magnets in housings

electrical arrangement the axial position of the shaft *D* can be "measured". It is arranged that the coils *H* serve as the two arms of a bridge circuit, and axial displacement of the shaft *D* therefore disturbs the balance of the bridge. A phase-sensitive detector in the circuit serves to sense in which direction that shaft has been displaced and to energize one of the coils *G*. As a result, the shaft is drawn back to the central position. A suitable electrical net-work is provided between the phase-detector and the coils *G* to ensure stability of the system.

Multiple Press Bending Operations on Tubular Frame Components

IN MULTIPLE BENDING, two or more bends are formed simultaneously in one or more workpieces at each press stroke. All bends are made in the same plane, but they may be of different angles and radii.

Many tubular furniture frames have U-shaped sections, which lend themselves particularly well to multiple press bending. For these operations, one company in the U.S.A. employs multiple-groove dies in a bending press made by Pines Engineering Co., Inc., Aurora, Ill.

Straight tubes are placed in the grooves of the clamp and wing dies, and positioned against a stop as seen in Fig. 1. As the ram-mounted punch tool moves downwards, it engages the workpieces, which are firmly held by hydraulic pressure exerted through the lower clamp die. With continued downward movement of the ram, the parts are wrapped against the die-shoes by twin air-cushioned wing dies which move on ways in the holders as bending progresses. Twin air cylinders provide the cushioning pressures through the holder crank arms. This arrangement eliminates rubbing and marring, and helps to ensure accurate bends.

The sectioned ram-mounted dies can be spaced to make frames with various distances between bends. Where the bend angles approach or exceed 90 deg., the end sections of the upper dies are actuated by a cam that moves them into the extended position for the bending stroke. Springs then retract the sections to release the workpieces and permit rapid unloading.

FOUR BENDS AND TWO COINING OPERATIONS COMBINED

U-frames for school furniture are produced, two at a time, in dies with double grooves. In each frame, two bends of different radii are made approximately 10 in. apart, and a coining operation is simultaneously performed at the centre. The workpieces are 44-in. lengths of 1⅛-in. outside-diameter steel tubing with a wall thickness of 0·065 in. They are swaged at both ends prior to bending. One bend is made through 71 deg., with a 3-in. centre-line radius, and the other, through 82 deg., with a 4-in. radius.

Midway between the bends, an area 2 in. long is flattened to one-half the tube diameter. In Fig. 2, the bending and coining of these U-frames have been completed and they are about to be released from the press. The flat is produced as the workpiece is clamped by a coining die-block that can be mounted either in the ram die or in the lower clamp die. This interchangeability enables the same set of dies to be used for the production of frames with either top or bottom flats.

A completed leg section of a school desk chair

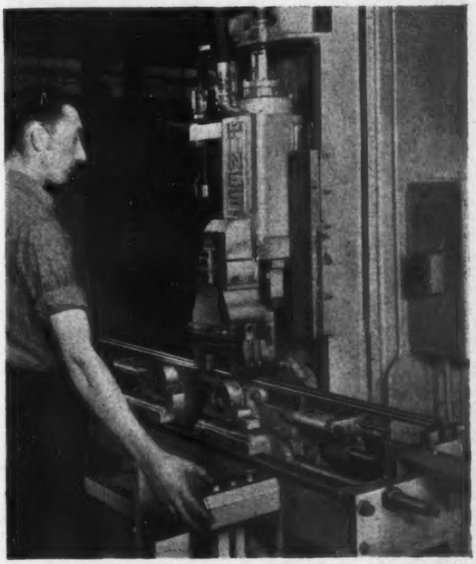


Fig. 1. Two straight lengths of steel tubing located and clamped for bending. At the end of the press cycle, the sectioned punch die is retracted to release the tubes

consists of two U-frames, one coined on the top and the other on the bottom, which are welded together as seen in Fig. 3. Production by this method averages 1,000 bends and 500 coining operations an hour. Formerly, separate handling was required for each bend, on account of the difference in radius, and 300 bends per hour were obtained. In addition, another press operation was required on each frame to produce the coined flat.

Changes of the tooling set-up on the bending press to accommodate other types and sizes of frames require, on average, less than an hour. A change involves replacement of the wing dies, the clamp die, and the ram-mounted punch die; setting the wing die positions; and adjustment of ram stroke for the new workpiece.

Other components for which the company employs multiple press bending include back-leg support sections for chairs. One size, formed from 1-in. outside diameter steel tubing, of 0·042-in. wall thickness, requires two 90-deg. bends 12⅜ in. apart, and of 3-in. centre line radius. Another size requires two 90-deg. bends 10½ in. apart, and of 1¾-in. centre line radius, in ¾-in. dia-

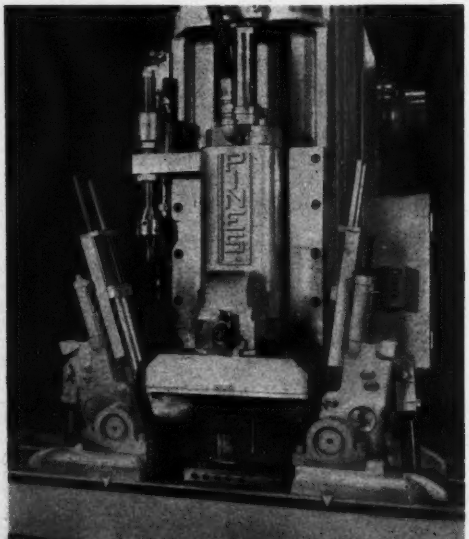


Fig. 2. The positions of the wing dies at the end of the forming stroke indicate the difference in the bend angles. The block in the ram-mounted die has coined a flat area at the centre of the U-frame as seen in Fig. 3

Fig. 3. Shaped by multiple press bending, these coined U-frames are crossed in the manner illustrated and welded to form legs for a school chair

meter tubing of 0·049-in. wall thickness. On both workpieces, average production exceeds 1,000 bends an hour, as compared with 300 bends by a former method.

DEX MULTI-SPINDLE DRILL HEAD PARTS.—A complete range of standard parts for Dex multi-spindle drill heads made by Designex (Coventry), Ltd., Broomfield Road, Earlsdon, Coventry, can now be supplied from stock. There are three main series of spindle assemblies for normal drilling and reaming; heavier work including the drilling of hard materials and rough boring; and heavy duty machining to accurate depths. A large selection of drive gears is stocked with teeth of 10, 12, and 16 d.p., also idler spindle assemblies designed to carry single or double transmission gears, and transfer spindle assemblies for transmitting drive from one compartment to another within the drill head casing.

The drill head casing is the only special item required, and it is made to suit the spindle layout. When using the Dex system, it is only necessary to prepare an outline drawing of the drill head casing with the hole centres indicated, the various spindle assemblies and gears being designated by code numbers.

Rheem Numerical-control Positioning System

A NUMERICAL CONTROL SYSTEM suitable for application to a wide range of machine tools, also processing equipment, stores management, scheduling, and production systems in general, has been developed by the Electronics Divisions of the Rheem Manufacturing Co., Los Angeles 45, Calif., U.S.A. One of the main advantages claimed for the system, as regards machine tool applications, is that decimal dimensions can be read directly from the working drawing of a part and can be punched into the tape, no conversion into an intermediate code being required. Of the servo type, the system can be used to control electric motors, hydraulic motors, also hydraulic and pneumatic cylinders, which can be arranged to move the main elements of a machine tool, for example, also to index turrets or tool holders.

Normally, standard, 1-in. wide, 8-channel Mylar aluminium laminated tape is employed, and is prepared with the aid of a Rheem keyboard and a standard Friden punch. The Rheem unit is a simple keyboard type device which is connected to the Friden tape punch and it is stated that an operator can be trained to use the equipment in about 30 min. Alternatively, the tape can be prepared with a standard Flexowriter machine, and this type of equipment is employed when an application requires the use of the EIA* binary code decimal tape system.

In Fig. 1 is shown a typical portion of tape which has been punched according to the Rheem system. It will be seen that the tape provides successive "blocks" of information, each comprising a direction indication (relative to a zero position), a decimal dimension, and various other items of information relating to auxiliary functions. Slightly to the left of the longitudinal centre line of the tape there is a row of smaller diameter holes which are engaged by the drive sprocket of the tape reader, also serve to indicate the position of the decimal point in any dimension.

The row of holes at the extreme right of the tape indicates the start of each successive block of information, also the direction or function which is to be controlled. It may be noted that the specimen section of tape here shown relates to a machine tool on which it is required to control the longitudinal and transverse movements of the worktable, the vertical movement of a knee or spindle quill, and the radial position of a tool in an adjustable-type boring head. The movements of the table in the longitudinal and transverse directions are covered by the X and Y dimensions respectively, movements in the vertical direction by the Z dimension, and adjustment of the tool radially by the R dimension.

On the portion of tape in Fig. 1, the various blocks of information have been divided up by horizontal chain-dotted lines, merely for purposes of illustration. In the first section—designated at the right-hand side as "X direction"— there are three punched holes. That to the left of the sprocket hole denotes that the next block of dimensional information is on the "plus" side of the table zero, thereby indicating the direction in which the table will be required to move. The hole to the

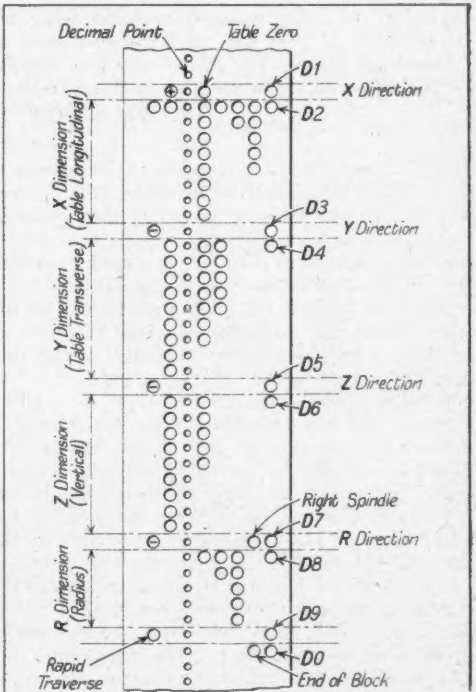


Fig. 1. A typical portion of a punched tape as employed for the Rheem numerical control positioning system is here shown

* Electronics Industries Association. This Association comprises representatives of most of the electronics manufacturers in the U.S.A. and incorporates a number of committees for establishing various standards within the industry.

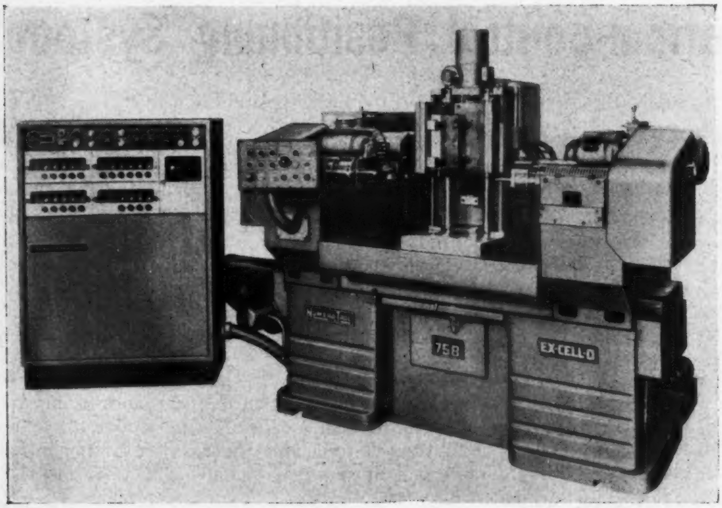


Fig. 2. Ex-Cell-O twin-head horizontal boring machine set up for boring operations on both sides of a test piece under the control of the Rheem numerical system. The punched tape also controls the radial positions of the boring tools, each of which can be adjusted through a distance of $\frac{1}{2}$ in. while the spindle is running

right of the sprocket line represents table zero, and the resultant signal derived from this hole ensures that initially the table is moved to that position. Finally, the hole marked D1 signals that an X-dimension movement is to follow, namely, a movement of the table in the longitudinal direction.

The hole marked D2, in the next block of the tape, provides a similar signal, but this time in relation to the information contained within the pair of chain-dotted lines designated "X-dimension, table longitudinal". This information indicates that the table is to be moved through a distance of 11·8125 in. from zero, in the plus direction. It will be seen that each hole represents the digit 1, and that the two holes to the left of the decimal point therefore indicate the whole number 11. The holes to the right of the decimal point—eight in number—represent ·8, and the next row has only one hole, indicating ·01. Similarly, the remaining two columns represent ·002 and ·0005, and the tape reader—which operates on a photo-electric principle—sums the number of holes in each column and builds up the required dimension.

The next block of information relates to transverse movement of the table—that is, in the *Y* direction—and it will be noted that a hole is punched two spaces to the left of the decimal point, to indicate that movement is to be in the "minus" direction relative to the table zero. The hole marked D3 indicates movement in the *Y* axis, since the control system is set to produce such a movement in response to the third (and fourth) signals received from that row of holes. Referring to the next block of dimensional information, it will be seen that there are nine holes in the column immediately to the left of the decimal point, and seven and five holes in the columns to the right. By this arrangement, the dimension 9·75 in. is indicated.

The first and sixth signals received from holes in the extreme right-hand column represent movements in the *Z* axis (vertical), and in the associated block of dimensional information the columns to the left and right of the decimal point have nine and five holes respectively, representing 9·5.

Signals from holes D7 and D8 are the seventh and eighth to be received from that column, and are recognized by the system as applying to an auxiliary function—in this instance an adjustable boring tool in the right-hand spindle of the machine. The block of dimensional information represents ·125 in., which is the distance through which the tool is required to be adjusted radially. In this instance, the tool will be withdrawn by 0·125 in. since a minus sign is indicated by the tape for movement in the *R* direction. Final signals representing rapid traverse and end-of-block are self-explanatory, and the procedure is then repeated, in the same sequence, for fresh movements in the *X*, *Y*, *Z* and *R* directions. It will be appreciated that, within reason, any number of auxiliary functions, apart from the three main machine movements, can be accommodated and controlled with this system.

As mentioned earlier, the tape reader is of the photo-electric type, and operates at a scanning speed of 100 lines per sec. It is stated that the average time required to read one block of information relating to the control of a 2-axis

system is 0·15 sec. Signals from the tape are fed to a bi-directional decimal summing register, which incorporates the necessary number of counting tube stages to provide for the degree of resolution and the lengths of traverse movement required. For example, for a resolution of 0·001 in., and a traverse distance of 99·999 in., five counting tube stages are required. The system can also be arranged to provide a resolution of 0·0001 in. As the distance to be moved is fed from the tape to the register, it is shown on tube displays, and with this arrangement the operator can readily check a new tape. For checking, the system is switched from fully-automatic to semi-automatic operation. Information is then read one block at a time and the reader will not proceed to the next block until a push-button has been depressed.

It may be noted that the system also enables dimensions to be "dialled-in", as may be required when machining single workpieces, such as parts for jigs and fixtures, for which a punched-tape is not justified. The register unit also incorporates the necessary power output elements to provide for rapid traverse movement, reduced speed movement (when approaching the required position), and for stopping the various drive systems. An important feature of the summing register unit is its bi-directional operation, which provides for counting distance increments either in the programmed direction, or the opposite direction. With this arrangement, it is claimed, the possibility of machine elements moving in the wrong direction when they are started or stopped rapidly is avoided, as is the possibility of "losing" counts in the same circumstances.

The position-monitoring system is of the rotary to digital converter type. For each axis of movement there are two magnetic sensing heads which detect changes in impedance of a rotating member and transmit pulses to the register unit. If a machine element is moved by a re-circulating ball nut and screw, the sensing heads can be applied to a disc member secured directly to the end of the screw. For movements which are affected by means of hydraulic cylinders, precision racks and pinions are employed, the disc member being secured to the pinion. The system can be set so that as the counts from the monitoring head for any movement approach the required total number a slower traverse speed is engaged, and this change-over can be arranged to take place only a few thousandths of an inch from the required final position.

APPLICATION OF THE SYSTEM TO AN EX-CELL-O TWIN-HEAD BORING MACHINE

In MACHINERY, 97/1065—9/11/60, brief reference was made to an Ex-Cell-O type 758 twin opposed-head horizontal boring machine which is equipped with Rheem numerical control and was displayed at the 1960 Chicago Machine Tool Exposition. A feature of this machine is that the tool in each boring spindle can be adjusted radially, a range of movement of ½ in. (corresponding to 1 in. on bore diameter) being provided. Moreover, this adjustment is made under punched-tape control and can be applied when the spindle is running, if required. It is stated that bore diameters can be machined within a tolerance of 0·0005 in. and that the limits of accuracy for positions and depths of holes (when shouldered) are ±0·0002 and 0·0005 in., respectively.

A general view of the Ex-Cell-O machine [Ex-Cell-O Corporation (Machine Tools) Ltd.] is shown in Fig. 2, where the combined Rheem tape-reader and control cabinet is seen at the left. For this application, the Rheem system is arranged for a resolution of 0·0001 in. and at the Exposition

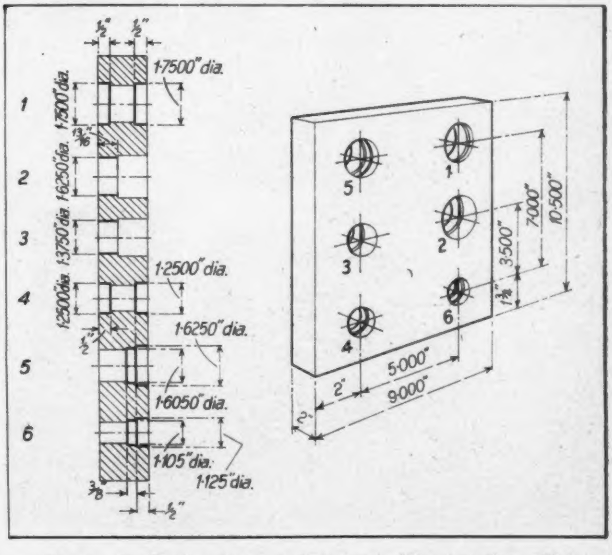


Fig. 3. Sectional and perspective views of the test piece which is bored at the set-up on the Ex-Cell-O twin-head machine which is illustrated in Fig. 2

demonstrations were given of boring operations on a special test piece. At the right in Fig. 3 is shown a perspective view of the test piece, and at the left a developed sectional view wherein the six different bores are included, complete with dimensions. The sequence of operations provided for boring holes No. 1, 2, 3, and 4 with the left-hand head and holes No. 1, 5, 4 and 6 with the right-hand head. It will be noted that holes No. 1 and 4 are counterbored from each side of the workpiece, and it is stated that close limits of concentricity were maintained for these bores. Holes No. 5 and 6 have stepped diameters, for which the tape-controlled adjustable boring head, mentioned above, was employed.

It is arranged that the larger bore is machined first in each instance, and that the tool is automatically reset for the smaller diameter before it is withdrawn, to avoid the possibility of marking the work.

TURRET-TYPE DRILLING MACHINE

Also in connection with the Chicago Machine Tool Exposition, reference was made in MACHINERY, 97/530—7/9/60, to equipment shown by the Burg Tool Manufacturing Co., Inc., Gardena, Calif., U.S.A., including tape-controlled turret-type drilling machines. One of these machines, arranged for control of the co-ordinate positioning table and the turret by the Rheem system, is shown in Fig. 4. Under the control of the punched tape, the work-table is moved successively to the required locations, and the 6-station turret is indexed to bring the specified tool to the working position. Holes in the tape also provide for automatically engaging rapid traverse for the turret slide, and for changing to the required feed rate as the tool approaches the work.

Fig. 4. This Burgmaster drilling machine is equipped with Rheem punched-tape control for the co-ordinate positioning work-table and the turret

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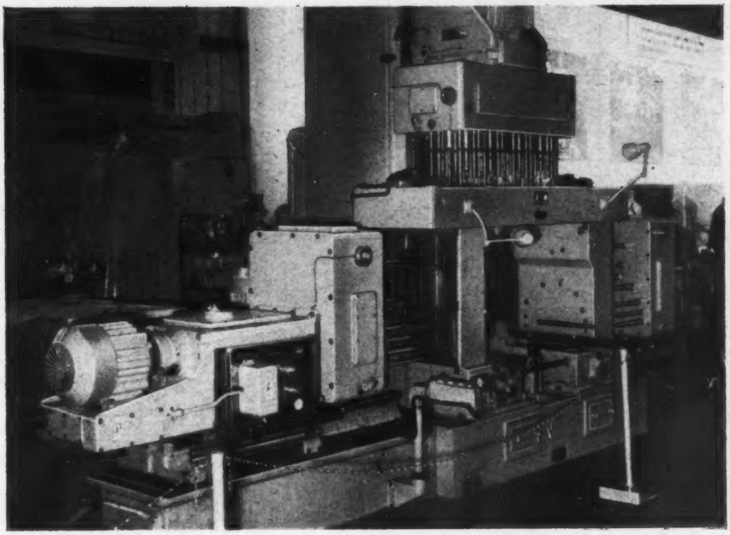
BOEING AIR BEARING OF IMPROVED DESIGN.—The Aero-Space Division of the Boeing Airplane Co., U.S.A., it is reported, has developed an improved design of air bearing which has been made for shaft sizes ranging from ½ to 5 in. diameter, and operated at speeds up to 100,000 r.p.m., with ambient operating temperatures in the range from −330 to +600 deg. F.

The design is stated to be simpler than that of the normal externally-pressurized bearing, where compressed air is admitted through a series of small holes in the housing, to form a supporting cushion for the shaft. With the new design, which is the subject of patents, a single, easily-drilled opening is provided. Pressurized air, entering the housing through this opening, becomes trapped in a shallow recess machined in the shaft, and the latter is thus lifted. The recess traps only enough air to meet load requirements. Air flow is throttled as it escapes from the recess, rather than at the inlet, as occurs with the multiple-orifice type of bearing.

It is expected that the bearing will find useful application to certain types of machine tools, high-speed turbines, nuclear equipment where radiation damages normal lubricants, and in the paper and food processing industries.

It is understood that the Boeing Airplane Co. is prepared to grant manufacturing licences for these bearings.

ELECTRONIC COMPUTERS to the value of £8,196,000 were produced during 1960, thereby maintaining a steady rise over the last four years. Exports also rose steadily, and for the years 1957 to 1960 inclusive were valued at £850,000, £1,023,000, £2,090,000 and £2,301,000.



Chinese Machine Tools at the Leipzig Fair

By R. E. GREEN, Associate Editor

MACHINE TOOLS AND ASSOCIATED EQUIPMENT formed the central feature of the exhibits in the permanent pavilion of the People's Republic of China at this year's Leipzig Spring Fair. Some 12 units were shown, and they attracted considerable interest from visitors, although few machines were in operation. Many of the machines bore obvious resemblances to Russian designs, probably as the result of the assistance that China is receiving from the U.S.S.R. The exhibits included a sliding-headstock automatic; a large 3-way, multi-spindle drilling machine; plain cylindrical, internal and centreless grinding machines; optical profile and gear grinders; gear hobbing and spiral bevel gear generating machines; a large jig borer; and a spark-erosion unit.

From information available it would appear that the planned increase in the output of machine tools in China during the five years from 1958 to 1962 inclusive was more than achieved by the end of 1959. During that year, some 70,000 metal-cutting machine tools were built, representing an increase of 40 per cent on the 1958 figure of 50,000 units, and some 5,000 to 10,000 more machines than the original plan had laid down for 1962. No figures have so far been issued for machine tool production in 1960, but the planned output was revised upwards during March last year to 90,000 units, an increase of about 29 per cent over 1959.

Part of this increase will consist of heavy machine tools, and of the so-called composite machine tools, one of which has been designed in co-operation with the Harbin Engineering Institute and built by the Chilien Machine Tool Factory, Harbin. This machine is designed for turning, planing, milling, drilling, boring and grinding operations, and comprises nine elements, which can be assembled as required. The machine was developed as a result of experience gained in the production of components beyond the normal capacity of the plant, by taking various machine tools to the workpiece instead of the reverse procedure.

Some of the increased output will consist of such units as planing machines incorporating reinforced concrete components, which, it is claimed, can be built in less time and with significant economies in

Fig. 1. This type C-104A, sliding-headstock automatic will accept bar material up to 0·157 in. diameter, and is intended for use in the watch, clock and instrument industries

the use of cast iron, still in short supply in China. A double-housing planer of this type, recently built by the Wuhan Heavy Machine Tools Plant, has capacity for parts up to 4·9 ft. square by 13 ft. long, and the use of reinforced concrete permitted a saving of some four tons of iron in the bed. If orthodox construction were adopted, the machine bed would have weighed some 9·6 tons, and its production would have required large foundry and machining facilities. With the new form of construction, the largest casting in the machine weighs only 0·65 tons. The Wuhan factory, it is reported, has also built the largest lathe so far made in China, with a swing of 16·4 ft., capable of accepting workpieces weighing up to 35 tons.

Other industrial exhibits in the Chinese pavilion at Leipzig included metallurgical products such as bars of carbon and alloy steel and non-ferrous metals, and it may be noted that recently-issued figures for Chinese steel production in 1960 show a total output of 18·45 million tons, more than double the target figure originally set for 1962. Electrical equipment, precision instruments, cutting tools, ball bearings, and telecommunication apparatus were also shown.

SLIDING-HEADSTOCK AUTOMATIC

The type C-104A sliding-headstock automatic shown in Fig. 1 has a capacity for workpieces up to 0·157 in. diameter, and is intended for the production of small components for the watch, clock, instrument and other industries. Drive is from a 2¼-h.p. motor, and there are 17 spindle speeds, ranging from 1,420 to 8,530 r.p.m. The camshaft speed can be varied to provide cycle times ranging from 1·3 to 250 sec. Bars up to 6 ft. 6 in. long can be used, and the maximum length that can be fed is 1·57 in.

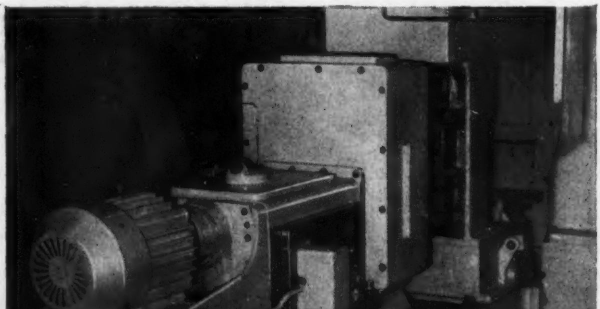
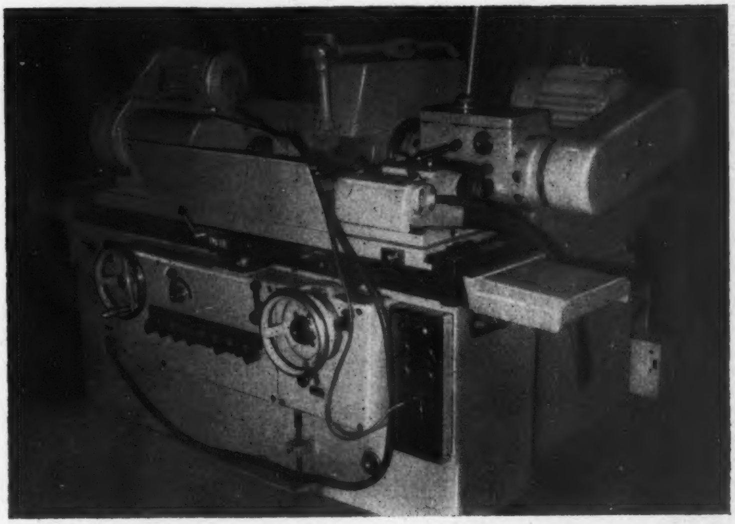


Fig. 2. Close-up view of one of the unit heads on the type UT 061, 3-way drilling machine in the heading illustration, for operations on engine crankcase castings. The machine has a total of 89 spindles and operates on a 4-min. cycle

Fig. 3. Made by the Shanghai Machine Tools Plant, this type M 120 B, plain cylindrical grinder has a capacity for parts from 0·315 to 7·87 in. diameter, by 27·95 in. between centres, and operates on an automatic cycle



There are six radial tool slides, and they are provided with micrometer adjustment, the knurled thimbles being graduated in divisions of 0·005 mm. (0·0002 in.) for the longitudinal, and 0·0005 mm. (0·00002 in.) for the transverse movements. The two near-vertical tool slides can be replaced with slides of special design which allow left- or right-hand under-cutting operations to be performed. A bar feed unit, seen at the right, is supplied with the machine, which has overall dimensions of 4 ft. by 2 ft. 8 in., by 4 ft. 7 in. high, and weighs just over 10 cwt.

THREE-WAY MULTI-SPINDLE DRILLING MACHINE

Placed opposite the main entrance to the pavilion, so as to make the greatest impact on visitors, was the type UT 061, 3-way multi-spindle drilling machine, a general view of which is shown in the heading illustration.

Designed for operations on large cylinder block castings, this machine has 89 spindles, and is driven by motors with a total of 35 h.p. Roller tracks are provided at each side of the central fixture to facilitate loading and unloading the casting (not shown), and it is roughly positioned by two stops. Dowels, which are raised and lowered by a single, manually-operated lever, provide for final location of the casting, and clamps are applied hydraulically to the top face of the workpiece by cylinders carried on the upper, horizontal bush plate.

Fig. 2 is a view, from the rear, showing one of the two, similar, horizontal unit heads employed on the machine. Each head is moved, by a hydraulic cylinder, on rectangular-section guideways on a bed unit fixed to the main machine base. Switches operated by dogs, that are adjustable in T-slotted bars at the sides of the bed unit, control the head movements and provide for fast approach, slow feed and rapid return movements. The machine is stated to operate on a cycle time of 4 min., and weighs some 14 tons.

CYLINDRICAL GRINDING MACHINE

The M 120 B, semi-automatic, plain cylindrical grinder shown in Fig. 3 was stated to have been built at the Shanghai Machine Tools Plant. The machine will accommodate workpieces from 0·315 to 7·87 in. diameter, and up to 27·95 in. long between centres, with a maximum weight of 330 lb. For grinding tapers, the table can be swung through 3 and 9 deg. in the clockwise and anti-clockwise directions, respectively. The table can be traversed, by hydraulic power, at speeds which are steplessly variable from 3·9 in. to 19·68 ft. per min.

With a new wheel, the peripheral speed is 6,900 ft. per min., and the wheel slide is advanced hydraulically. Work-spindle speeds can be varied from 40 to 226 r.p.m., in four steps, by means of cone pulleys, and the total power of the motors is 9·38 h.p. An electrically-operated caliper gauging instrument on the table is advanced hydraulically to engage the work at the start of the grinding operation, and serves to control the cycle automatically. On a test piece of 1·5 in. diameter by 15 in. long, it was stated, total tolerances of 0·004 mm. (0·00016 in.) for ovality, and 0·007 mm. (0·00028 in.) for taper were maintained, with a high-quality surface finish.

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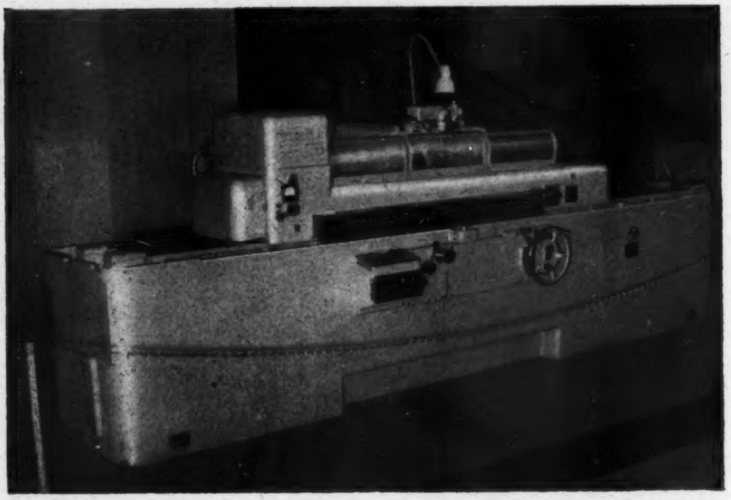

Fig. 4. This Y-750 K, thread-grinding machine, also constructed by the Shanghai factory, will take components up to 7·87 in. diameter by 53 in. long between centres, and will grind metric, module and English threads

THREAD GRINDING MACHINE

Another example from the range of machines built by the Shanghai Machine Tools Plant is the type Y-750K, thread grinding machine shown in Fig. 4, which was stated to be of original Chinese design. The maximum diameter of workpiece is 7·87 in., and parts up to 53 in. long can be accommodated between centres. Threads from 0·78 to 5·9 in. diameter can be ground with a single-start wheel, and from 0·78 to 4·7 in. diameter with a multi-start wheel. Pitches from 1·5 to 24 mm. in the metric system, and 1 to 8 mm. module, can be ground, also inch sizes from 3 to 14 t.p.i.

The work-spindle is driven by a d.c. motor, which is supplied with current from an electronic unit, so that the speed of the spindle, also that of the table, can be steplessly varied. Compensating mechanism in the drive from the work-spindle to the table leadscrew allows grinding to be performed in both directions of table traverse if required. Direction of table movement is reversed automatically at the end of each stroke by means of adjustable dogs beneath a guard at the front of the table, and the bed-ways are covered by steel strips to protect them from airborne abrasive. Trueing of the grinding wheel is performed automatically.

Specific claims are made as to the accuracy with which screw threads up to 6 mm. (0·236 in.) pitch can be finished on the machine. Limits on the pitch are held to ±0·003 mm. (0·00012 in.), cumulative pitch error over 100 mm. (3·9 in.) is held to ±0·006 mm. (0·00024 in.), and over the whole capacity of the machine to ±0·02 mm. (0·0008 in.). The accuracy of the pitch diameter

Fig. 5. Internal grinding of workpieces is performed automatically in this type M 205 Z1, machine, in which the parts from a magazine are loaded into chucks on spindles in a 3-position indexing drum and automatically discharged after the completion of grinding

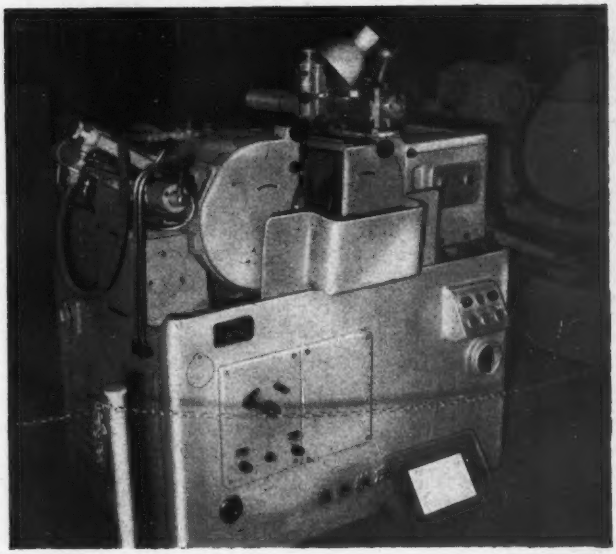

Fig. 6. This small type M 1050, centreless grinding machine will accept work from 0·031 to 1·96 in. diameter, and will grind parts up to 5·9 in. long by the in-feed method. Wheel-dressing is performed hydraulically

is held to ±0·005 mm. (0·0002 in.). The machine measures some 4 ft. 10 in., by 6 ft. 10 in., by 14 ft. 5 in. long, and weighs approximately 7 tons.

AUTOMATIC INTERNAL GRINDING MACHINE

The type M 205 Z1, automatic internal grinding machine shown in Fig. 5 is of interesting design, and provides for transfer of the workpieces from a magazine to the grinding and unloading positions. The capacity of the machine is limited to workpieces of 1·18 to 1·96 in. internal diameter, and with a maximum overall length of 2·125 in. Components placed in the magazine chute descend automatically to a position from which each is pushed forward into the jaws of a chuck carried on one of three spindles in a drum within the circular housing.

When the drum is indexed through 120 deg., the component is carried to the lower (grinding) position, where the spindle is automatically coupled to the main drive and rotated at speeds of 480 to 680 r.p.m. The wheel-spindle, carried on the table in front of the housing, is driven at 24,000 r.p.m., by a 2·7-h.p. motor, and the table has a maximum stroke length of 15·75 in. As the wheel is advanced, it can be dressed by a diamond, held in a swivelling holder at one side. After the grinding cycle has been completed, the wheel is retracted and the drum is again indexed to carry the part up to the unloading position at the further side of the circular housing. Here, the chuck jaws are opened, and the component is ejected down a chute leading out of the machine.

On the installation shown, the wheel-spindle bearings appeared to be air-cooled, and provision was made for the supply of coolant through the

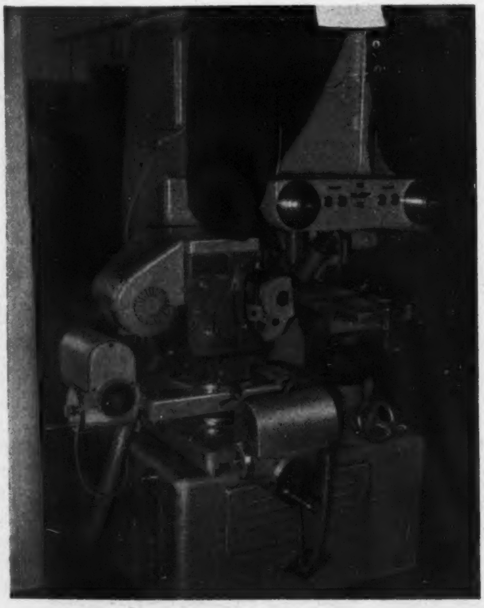

Fig. 7. This type M 695, optical-projection, profile-grinding machine, built by the Wuhan Machine Tool Works, will grind portions of workpieces measuring up to 0·39 in. in each direction, and has a screen on which the work and wheel are seen at 50× magnification

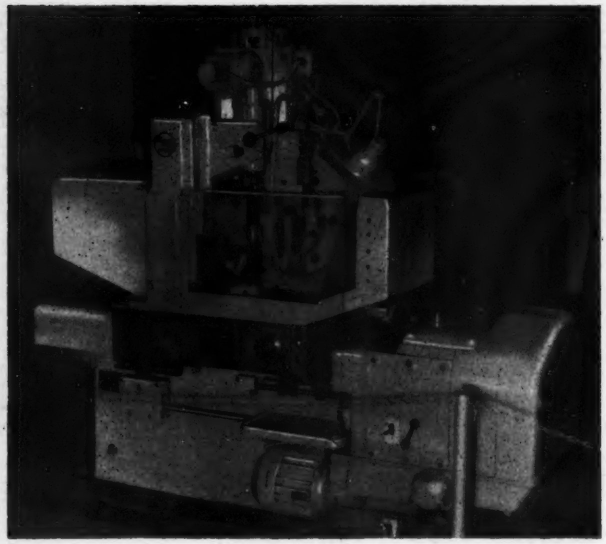

Fig. 8. Another product of the Shanghai Machine Tools Plant, this automatic gear grinding machine, type Y 7131, is similar to a Russian design and will grind gears of 1·18 to 12·59 in. diameter

centre of the spindle. The coolant was pumped to a magnetic-drum clarifier in a floor-mounted unit at the rear of the machine.

CENTRELESS GRINDER

Made at the same factory as the internal grinding machine, the type M 1050 centreless grinder, shown in Fig. 6, has a capacity for work from 0·031 to 1·96 in. diameter, and, in the standard form, will grind parts up to 5·9 in long. The grinding wheel is of 13·78 in. diameter, and 5 in. wide, and is driven at 3,000 r.p.m. by a 9-h.p. motor. Wheel dressing is performed by a hydraulically-operated slide, mounted externally at the left, and the wheel spindle bearings are in a fixed position on the bed.

The control wheel is carried on a slide at the right, which is operated by means of a hand lever, in the conventional manner, for in-feed grinding. This wheel is of 9·84 in. diameter, by 2·95 in. face width, and the wheel speed can be varied steplessly between 20 and 180 r.p.m. An external, hydraulically-operated dressing unit is mounted above the wheel housing.

OPTICAL PROFILE GRINDER

Built by the Wuhan Machine Tool Works, the type M695 optical projection profile grinding machine shown in Fig. 7, is similar to the Russian-type 395M machine, made by the Leningrad machine tool plant. Portions of work-pieces, measuring up to 0·39 in. in each direction, can be ground without re-setting, and the machine has a capacity for parts with maximum dimensions of 5·9 by 2·36 in., by 1·88 in. high. Setting of the work is carried out with the aid of gauge blocks, which are inserted between datum faces on the table and saddle. The table can be adjusted through distances of 3·9, 2·36 and 5·9 in. in the vertical, longitudinal and transverse directions, respectively.

The wheel spindle is driven at a speed of 3,500 r.p.m. by a 0·8-h.p. motor, and is fitted with a grinding wheel of 4·9 in. diameter. The spindle housing is carried on a slide, which is reciprocated by a separate motor, through a link mechanism, at rates of 45 to 85 strokes per min. Provision is made for tilting the slide from its vertical position through 10 deg. in one direction, and 30 deg. in the opposite direction, the spindle axis remaining horizontal. The complete wheel-head can be adjusted about a horizontal axis to tilt the wheel spindle through 10 deg. in each direction. The wheel-head is carried on a compound slide, each member of which can be moved either by hand, or through rheostat-controlled d.c. electric motors to give traverse speeds of 0·008 to 0·78 in. per min. Each member of the compound slide assembly can be swung in a horizontal plane through 45 deg. on either side of its zero setting. The traverse of the upper member is 5·9 in. and that of the lower member is 5·12 in.

Above the grinding area of the machine is an optical projection system, with a screen measuring 20 in. square, whereon images of the work and the edge of the grinding wheel are projected at a magnification of 50 ×. Abrasive dust generated during the grinding operations is extracted by an exhaust system powered by a 0·8-h.p. motor, and a motor-generator unit of similar size provides d.c. power for the wheel-head slides. The machine measures about 4 ft. 10 in. by 5 ft. 3 in. by 6 ft. 6 in. high, and weighs approximately 1·5 tons.

AUTOMATIC GEAR GRINDING MACHINE

The type Y 7131 automatic spur and helical gear grinding machine, Fig. 8, is built by the Shanghai Machine Tools Plant, and is similar to the Russian type 5831 machine, made by the Moscow grinding machine works. Operating on the generating principle, the machine employs a wheel which is form-dressed to the shape of a basic rack, and it can also be used for grinding gear-shaping and -shaving cutters. Gears from 1·18 to 12·59 in. diameter, with 12 to 200 teeth of 1·5 to 6 mm. module (16·9 to 4·2 d.p.), can be ground, and the maximum face width for spur gears is 3·9 in. Maximum face widths of helical gears with helix angles of 15 and 45 deg. (the maximum) are 3·8 and 2·8 in. respectively.

Of 9·4 in. maximum diameter by 0·63 in. wide, the formed wheel is driven by a 1-h.p. motor at a speed of 2,575 r.p.m. The spindle slide moves on guideways in a support that can be tilted 45 deg. on either side of the vertical setting, and the slide can be reciprocated at any of six speeds, from 50 to 280 double strokes per min. With the wheel slide moving up and down, the gear is ground by a series of horizontal movements of the table, during which the gear rolls in mesh with the wheel form, so that adjacent flanks of two teeth are ground as the table moves first in one direction and then in the other. The table has a maximum travel of 7·87 in., and there are 12 feed rates ranging from 2·2 to 34 in. per min.

The table carries a circular faceplate, of 12·6 in. diameter, with a central hole bored to No. 3 Morse taper, to receive arbors whereon the gears to be ground are mounted. When the table reaches the left-hand end of its traverse, the faceplate is automatically indexed through an angle to suit the number of teeth in the gear. After all the teeth have been ground, the machine stops automatically. Wheel dressing is performed by a built-in unit, and automatic compensation is made for the abrasive material removed. The machine measures 7 ft. 10 in. by 6 ft. 11 in. by 7 ft. high, and weighs approximately 4·5 tons.

LARGE JIG BORING MACHINE

Stated to be built in Kunming, the T 463 jig boring machine shown in Fig. 9, is similar to the Russian type 2450 machine, which, itself, closely resembles the Lindner type LB 15 machine described in MACHINERY, 81/588—18/9/52, and has a table measuring 43·3 by 24·8 in. Movements of the table in the longitudinal and transverse directions are 39·37 and 23·6 in., respectively, and the distance from the end of the spindle to the table can be varied between 9·8 and 29·5 in. The table moves on rollers on hardened steel strips on the bed and saddle, with flat central guideways to ensure straight-line travel. Adjustable gibs provide for taking up wear, and the guideways are protected by rubberized strips. Electric switches, actuated by stops on the table and saddle, prevent over-travel.

Drive to the table and saddle is by a flange-mounted 0·67-h.p. motor, through a roller chain, gears and a friction clutch. There are two traverse rates, of 1·4 and 39·4 in. per min., so that limited milling operations can be performed if desired. Hand wheels are also provided for fine adjustment of the table and saddle positions. After setting has been completed, clamping of the table and saddle

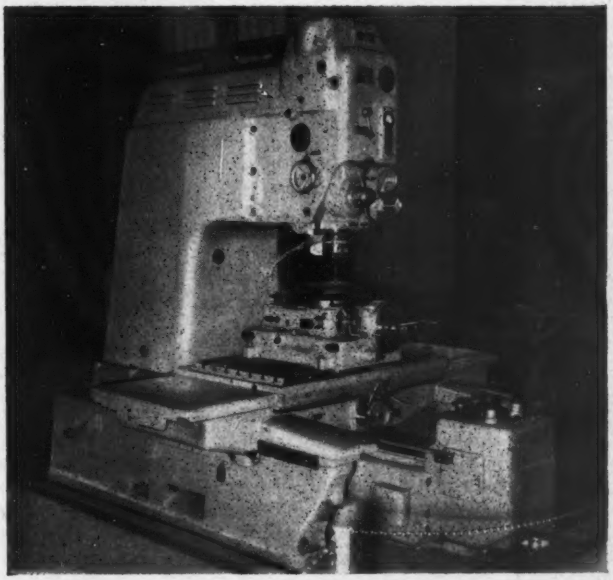

Fig. 9. Designated T 463, and said to be built in Kunming, this Chinese jig borer has a table measuring 43·3 by 24·8 in., and has a positioning system that employs cylindrical stainless steel bars engraved with helical lines

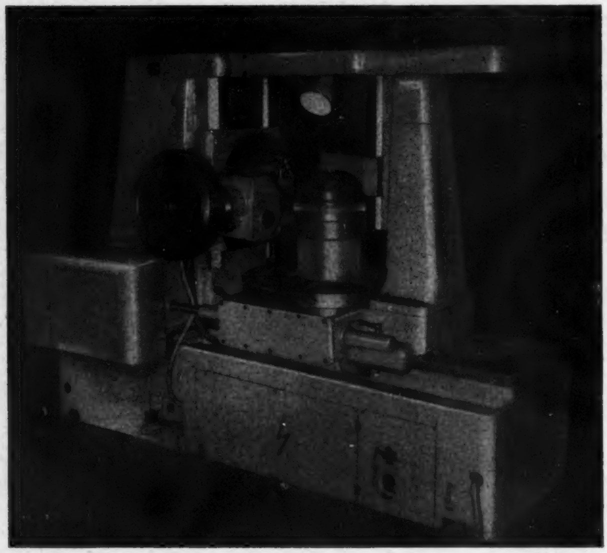

Fig. 10. Of straightforward design, this type Y 3180, universal gear hobbing machine will cut gears up to 3·17 d.p., and of 21·6 in. maximum diameter, with the supporting column in position

is effected by means of levers, which apply pressure through steel bands, so that the accuracy of the settings is not disturbed.

The machine is equipped with an optical measuring system that employs precision scales in the form of highly-polished, cylindrical stainless steel bars, engraved with a continuous helical line. One of these bars is mounted in the table and one in the saddle, and they allow settings to be repeated within ±0·01 mm. (0·0004 in.), in conjunction with external scales and vernier dials. The lines on the bars are viewed through microscopes on the housing at the front of the bed at a magnification of 40×, and after turning the appropriate bar to obtain the required vernier setting, the scale line is centred between two parallel graticule lines by further small movements of the table or saddle.

Three steplessly-variable spindle speed ranges are obtained by means of a 2·68-h.p. d.c. motor, supplied by a generator set. Drive is transmitted through a gearbox, giving speeds from 50 to 1,900 r.p.m. The spindle head has a travel of 9·8 in. on V-ways, and the quill is fed through a similar distance by a ring-and-cone type friction-drive mechanism, at steplessly-variable rates of 0·0012 to 0·0063 in. per spindle rev. The spindle head and quill can be securely clamped in any vertical position when milling or other operations are performed.

The machine shown is fitted with a universal rotary indexing table, of 17·32 in. diameter, which can be tilted through an angle of 90 deg. Angular settings of this table can be made to ±10 sec., and the angle of tilt can be set within 1 min. by means of vernier scales.

UNIVERSAL GEAR HOBBER

Fig. 10 shows the type Y 3180, 800-mm. universal gear hobbing machine from the rear. This machine was built by the Chungking Machine Tool Works, and shows evidence of

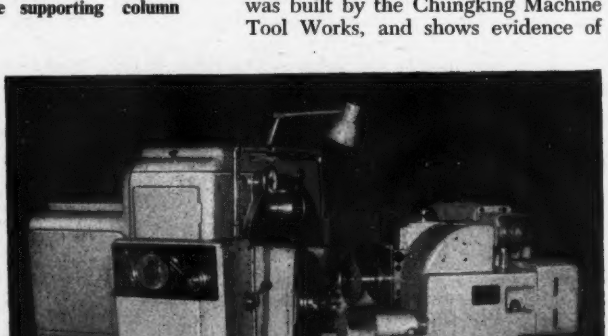

Fig. 11. Built at the Tientsin First Machine Tool Works, this automatic spiral bevel and hypoid gear generator is similar to a machine developed by the ENIMS research station, Moscow

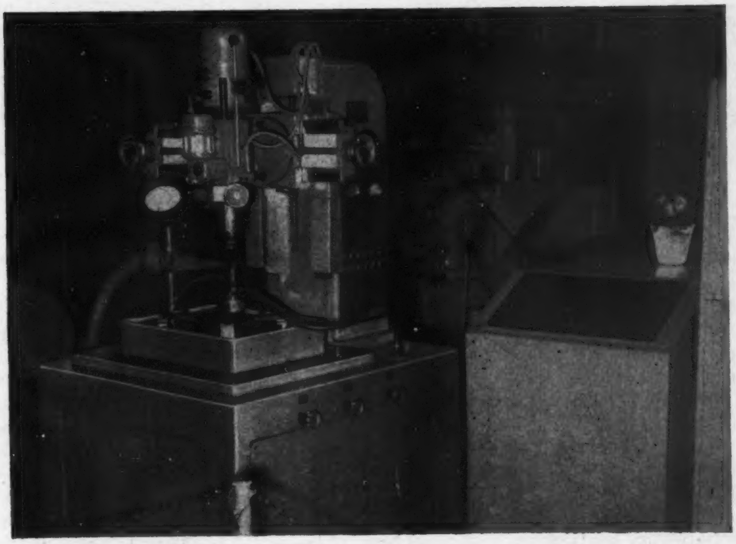

Fig. 12. Working on a new principle, this type DM 554, electro-impulse machine employs a special generating unit and is capable of removing up to 0·07 cu. in. of metal per min. Electrode wear ranges from 0·2 to 25 per cent of the metal removal rate

original Chinese design. It has capacity for cutting gears of up to 8 mm. module (3·17 d.p.), and with the outboard support column in position as shown, gears up to 21·6 in. diameter can be cut. Without this support, the machine can be used for cutting gears up to 31·5 in. diameter. Spur gears with face widths up to 9·45 in., or stacks of equivalent length, can be hobbed.

For helical gears with helix angles of 30 and 60 deg., the maximum diameters are 19·68 and 7·48 in. respectively. Drive is from a main motor of 3·75 h.p., and there are eight cutter spindle speeds, ranging from 47·5 to 250 r.p.m. Gears are cut by conventional hobbing, and there are 10 feed rates for the hob slide, ranging from 0·019 to 0·157 in. per work rev.

AUTOMATIC SPIRAL BEVEL AND HYPOID GEAR GENERATOR

Built at the Tientsin First Machine Tool Works, the type Y 225 spiral bevel gear generator shown in Fig. 11, is similar to the Russian type 525 machine, described in MACHINERY, 98/1251—31/5/61. The machine is designed for roughing or finishing operations on spiral bevel and hypoid gears, from 2·5 to 10 mm. module. Gears of 19·68 in. maximum diameter, can be cut, with interior cone angles of 4 to 90 deg. and maximum tooth width and depth of 2·56 and 0·787 in. respectively.

The machine is driven by a motor of 8·3 h.p., and there are 12 cutter-spindle speeds, from 25 to 325 r.p.m., the range of feed rates providing for cutting one complete tooth in periods of 4·5 to 78 sec. Clamping of the workpiece, moving the work-head to and from the cutting position, operation of rapid traverse clutches and other mechanisms are all performed hydraulically. The machine measures 7 ft. 2·6 in. by 5 ft. 3 in., and is 5 ft. 3 in. high. The overall weight is stated to be approximately 6·2 tons.

ELECTRO-IMPULSE MACHINING UNIT

The electro-impulse machining equipment seen in Fig. 12, was built by the Machine Tool Research Institute, Peking. Designated type DM 554, it is designed for the production of die and mould cavities. With a table measuring 15·75 by 19·68 in., the machine can accept workpieces up to 15·75 by 13·78 by 5·5 in. high, and it is claimed that it operates at a very high efficiency. Reference was made to electro-impulse machining at the Russian research institute ENIMS in MACHINERY, 96/44—6/1/60, and it may be recalled that material is removed from the workpiece, which is immersed in a dielectric fluid, by means of arc discharges that are arranged to occur at a fixed frequency.

On the machine shown, which has a total power consumption of 10·5 kW., electrical impulses are produced by a special generator unit, seen at the right, at the rate of 400 per sec. The average no-load voltage is 32, and the normal current 80 amp., the generator having an output of 4·3 kW. For ideal results, the optimum area of the cavity to be sunk is 6·2 sq. in., but cavities having areas up to 46·5 sq. in. can be produced on the machine. The maximum rate of metal removal is 0·07 cu. in. per min., and the rate of electrode wear varies from 0·2 to 25 per cent of that metal removal rate.

Assessment of Surface Finish by Means of Surface Roughness Scales

By M. P. RUBERT, A.M.I.Prod.E.

THE NECESSITY of keeping the surface finishes of many machined components within specified limits is generally accepted today and the application of surface finish control is becoming increasingly widespread. In this connection, however, problems may arise in combining such control with economical production.

Surface finish assessment methods can be divided into four groups:

(1) Measurement with electronic stylus instruments of the modulated type (Talysurf 3, Perth-o-Meter, Profile-o-Meter).

(2) Measurement or comparison with an optical interference microscope.

(3) Comparison by means of electronic instruments of the piezzo-electric type (Talysurf 100, Philips, Sigma, Bruehl & Kjaer, and many others).

(4) Comparison with surface roughness scales or standard specimens.

Group (1) methods give the most accurate assessment.

Group (2) methods are occasionally used for research and laboratories but are unsuitable for application in the machine shop.

Group (3) instruments do not measure but only compare. They are much less expensive than instruments which come within group (1), but the accuracy is not sufficiently high for research or standard work and such instruments are primarily intended for machine shop use.

Comparison scales or standard specimens (group 4) provide a simple and economical means of surface finish control, and have become well established in precision engineering in many countries.

Whereas the accuracy of the instruments in group (1) for standards work cannot be equalled by any other means, the advantages and disadvantages of methods which fall within groups (3) and (4) have been extensively investigated during recent years. Many research organizations and important manufacturing concerns have independently established that the percentage accuracy of assessment by means of surface roughness scales is equivalent to that obtainable with a piezzo-electric comparator. Because of their robustness, low price, and simplicity in application, together with the fact that machine operators, with very few exceptions, can use them without special instructions, roughness scales are very valuable in the machine shop.

There are still, however, many engineers who do not approve of comparison by sight and touch for various reasons, including the following.

(1) They have experienced disappointment with inferior or badly worn standard specimens.

(2) They have compared finishes produced by a certain machining method with surface roughness standards produced by a different machining method and have therefore obtained unsatisfactory results.

(3) They have never tried surface roughness scales and tend to believe that scratching samples with a finger-nail is not sufficiently scientific.

(4) Insufficient information is available and very little has been published on the reliability, percentage accuracy, and limitations of subjective comparison.

Recently, however, valuable research work in this field has been carried out by the Physikalisch-Technische Bundersanstalt in Braunschweig (the German equivalent to the NPL) (Ref. 1 and 2)* where Dr. Hasing has made extensive tests and established various important facts such as:—

(1) The best comparison results are obtained by sight and touch. Visual comparison alone gives very inferior results.

(2) Surfaces designated in CLA can be better assessed by touch than those designated in maximal depth (the predominant standard in Germany) (Ref. 3, 4 and 5) but not so well as those designated in "levelling depth" or "depth of smoothness" (the German "glattungstiefe") (Ref. 6 and 7).

(3) In the case of roughness values with ratios of approximately 2·5 to 1 and over, complete agreement of the individual opinions may be expected. The writer has independently conducted very similar tests, during which up to 100 people assessed hundreds of specimens by sight and touch, and the results, statistically evaluated, confirmed the findings of Dr. Hasing.

With regard to (3), the writer found that 100 per cent agreement of a large number of people when comparing by sight and touch can only be

* All references at end of article.

obtained with roughness differences of at least 2·3 : 1. It would, however, be wrong to conclude that the percentage difference necessary for reliable sight and touch comparison is 130. It was found that out of 100 people, only two failed to detect a difference of 100 per cent and only one a difference of 125 per cent. Indeed, 91 out of 100 people were able to detect a difference of 20 per cent and 95 people out of 100 a difference of 25 per cent. It is therefore safe and fair to assume that the percentage difference which can be assessed by sight and touch is between 20 and 25 per cent for *ground* surfaces of 2 to 125 micro-inches CLA. For the tests, the results of which are recorded in Fig. 1 and 2, 100 people of various ages, professions, skills and educational standards were selected.

It might be argued that a testing system which only 90 to 95 per cent of average people can operate successfully is not as reliable as the use of an electronic instrument, the pointer position of which can be seen by every normal person. On the other hand, it must be pointed out that the use of all types of surface roughness measuring or comparing instruments requires a certain standard of intelligence and skill. Out of 100 people of such diversity as were chosen for the above mentioned tests, a proportion would certainly not be suitable to apply surface roughness measuring instruments. The qualifications required to operate instruments, moreover, are of a different nature from those necessary for the use of surface roughness scales, the latter requiring only a normally developed sense of touch and a finger-nail of a reasonable length (lack of which is the most common cause of errors).

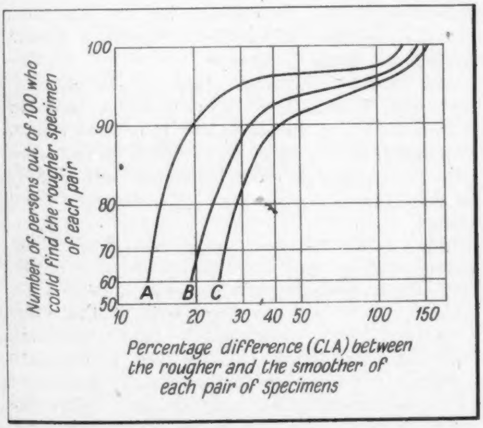

Fig. 1. For the test, 100 people were asked to say which specimen of each pair was the rougher. Curve *A* relates to 15 pairs of ground specimens, of which the smoother ones were between 2 and 125 micro-inches CLA; curve *B*, to 15 pairs of ground specimens, of which the smoother ones were between 32 and 500 micro-inches CLA; and curve *C*, to 15 pairs of turned and shaped specimens, of which the smoother ones were between 25 and 250 micro-inches CLA

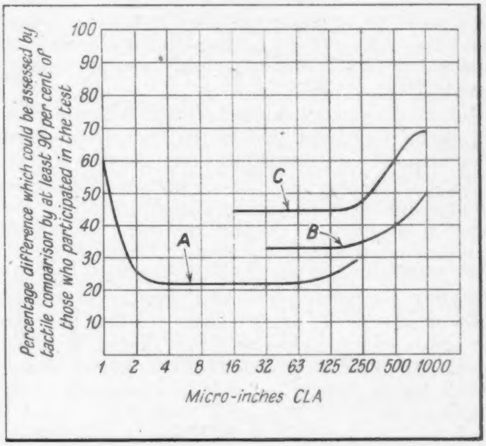

Fig. 2. Curves showing the degree of discrimination afforded by tactile comparison. *A*—lapped, honed, and ground surfaces. *B*—milled surfaces. *C*—turned and shaped surfaces

The majority of the 100 people tested had never used surface roughness scales before, and it has been found that with even a short period of practice the results obtained normally improve. Similarly, it may be pointed out, some kind of instruction and training must be given before even the most simple surface measuring instrument can be operated successfully.

HOW IS TACTILE COMPARISON MADE?

According to Fig. 1 it is possible to determine with the use of comparator scales whether an unknown surface is finished, for example, to 2 or 4 micro-inches CLA, which represents, approximately, a difference between 18 and 32 micro-inches peak to valley height (see Ref. 3 and 10). The question then arises, how is it possible to register such minute differences of length with a finger-nail, the radius of which is about 0·01 in. Fig. 3 shows the relative dimensions of a surface of 4 micro-inches CLA, the stylus tip of a

measuring instrument of 0·0001-in. radius (R_2) and the radius of a finger-nail R_1. It will be noted that the stylus tip can penetrate to the bottom of the valley, which the finger-nail certainly cannot reach.

To understand this apparent contradiction it is necessary to realize that tactile comparison does not depend on registering the depths of the irregularities but only small fractions of those depths, and that reliance is placed mainly on the spacing or pitch in conjunction with the shapes (radii of curvature) of the peaks. Since, however, the ratio of pitch to total depth produced by grinding, lapping and honing varies only little between 2 and 125 micro inches CLA, it is possible to assess very closely the actual depths of these surfaces. This fact was already realized many years ago as a result of extensive research work carried out by the Warner & Swasey Co., U.S.A., and reported by Michael W. Papp in MACHINERY (see Ref. 11).

Surfaces produced by single cutting edges, however, as in turning, shaping or planing, can be assessed only to a considerably inferior degree of accuracy since, for such surfaces, the ratio of pitch to depth varies considerably depending on the shape of the cutting tool and the feed rate. When assessing these surfaces tactile comparison should be supplemented by visual inspection. The same applies to a milled surface, which, although not produced by a single cutting edge, cannot be placed in the same category as surfaces produced by abrasive methods.

HOW TO USE SURFACE ROUGHNESS SCALES

To obtain the best results it is advisable to practise for a few minutes and for this purpose two sets of numerically designated scales should be used, and one of these sets at least should be such that the specimens can be removed and later replaced (Fig. 4). One after the other, single specimens should be taken out, the values of which are not known to the operator, who should then try to find the corresponding value in the other set by tactile comparison. The individual specimens should, if possible, be not less than 1 by ⅝ in. as specified in BS.2634/60. A special warning is necessary against the use of electro-formed surface roughness scales which are less than 1 by ⅝ in., since these surfaces, however accurate they may be as regards roughness values, have significant errors of form which are inherent in the production process. Specimens even slightly less than 1 in. long may not give adequate comparison.

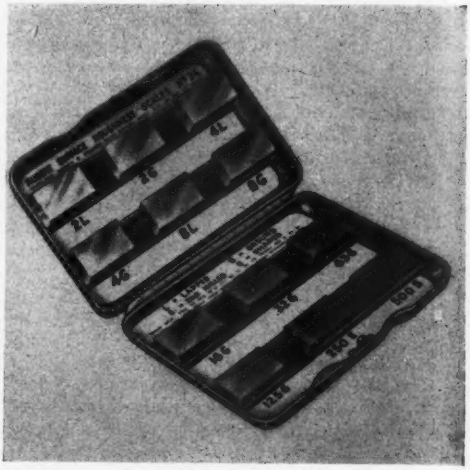

Fig. 4. A typical set of surface roughness scales as employed for tactile comparison of finishes

Undoubtedly, the best results are obtained by running a clean finger-nail across the lay of the surface to be assessed and then running the same finger-nail at the same speed and pressure, across the scales until the two nearest scales—one rougher and one smoother than the unknown surface — have been found. The figure relating to the rougher scale is then taken as the value for the surface. Most scales are calibrated in increments of 100 per cent (1, 2, 4, 8, 16, 32, 63, 125 and 500 micro-inches CLA ac-

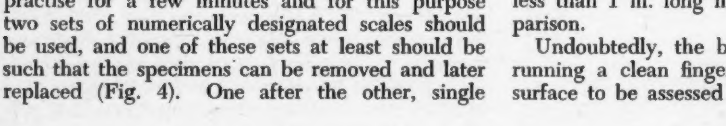

Fig. 3. Profile of a ground surface of 4 micro-inches CLA. The magnification, both horizontally and vertically, is approximately 2,000×

cording to BS.2634/60; Part. 1. These steps may seem large but in fact they are quite adequate as explained in BS.1134 (Ref. 9).

When using the finger-nail it is advisable to ensure that it is free from abrasive dust. The finger-nail itself can do little damage to the scales but particles of dust may cause irreparable damage to the scales even if they are of hardened steel.

As mentioned previously, only about 95 per cent of average people are able to assess successfully by tactile comparison and not all of them use a finger-nail. Some people—although very few—obtain satisfactory results by using only the tip of a finger. The few people who cannot make direct tactile comparison should try the use of a metallic disc such as a copper coin. For finer surfaces, especially, the use of a coin can be of great assistance. With this method, it is advisable to hold the coin firmly but to apply only slight pressure to the surface with the edge.

TACTILE COMPARISON AND SURFACE GEOMETRY

Whereas in Britain only the CLA standard for designating surface roughness has been adopted, in other countries, and especially in Germany, apart from CLA, "maximal depth" and the so-called "levelling depth" (Ref. 3, 4, 5, 6 and 7) are employed. It is becoming more and more apparent that the designation according to the "levelling depth" standard represents the true surface quality much more closely than any other standard. The writer is of the opinion that sooner or later it will be necessary also in Britain to adopt another standard, based either on the "maximal depth" or "levelling depth" in conjunction with CLA.

Some people were of the opinion that the CLA standard in conjunction with specification of the machining process was all that was needed, but the inadequacy of CLA is becoming more and more apparent and instruments for measuring "maximal depth" and "levelling depth" are becoming increasingly popular. In conjunction with these facts it should be mentioned that the degree of accuracy of tactile comparison is much better when the surfaces are designated in "levelling depth" than in any other standard (Ref. 1 and 2). It appears, therefore, that when performing tactile comparison one is actually evaluating a hitherto unknown parameter, which, however, is very similar to the "levelling depth," and that the latter is most closely related to the actual frictional surface quality. The "levelling depth" is defined as the "maximal depth" minus the "mean depth" which should not be confused with the arithmetical average depth (CLA).

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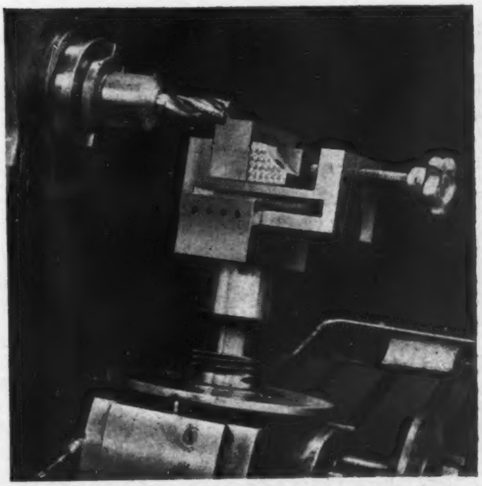
Method of Mounting a Vice on a Dividing Head for Compound-angle Milling

By H. J. Gerber

A shell end-mill arbor and an adapter block can be used to mount a small drill vice on the spindle of a universal dividing head, as seen in the accompanying figure, for milling compound angles on small tool and gauge components.

The block is machined with a channel which receives the base of the vice, and the latter is clamped in position by means of set screws. The bottom of the block has a slot which fits the two driving lugs of the arbor, and there is a counterbored hole in the centre for a cap screw which secures the two members together.



Set-up for milling a compound angle in a workpiece held in a vice, supported from a dividing head

Design of a Typical Work-head Spindle for a Wotan Grinder

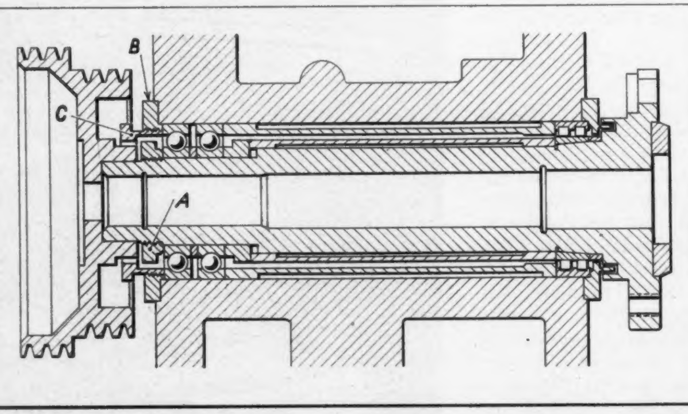
THE INCREASING DEMAND for interchangeability of quantity-produced workpieces, for example, parts for anti-friction bearings and aircraft engines, has brought about a complementary demand for closer tolerances in many branches of production engineering, particularly in connection with grinding operations. In this field, the limits of accuracy for geometrical form and standard of surface finish have become progressively more exacting, moreover, such limits are now being applied to larger and heavier workpieces. As a result, attention has been directed towards improving the already high accuracy of grinding machines. As regards the concentricity performance of spindles for work-heads, for example, some noteworthy advances have been made by Wotan-Werke, Düsseldorf, Germany. As is well-known, the company builds a wide range of internal grinding machines, and is represented in this country by Soag Machine Tools, Ltd., Juxon Street, Lambeth, London, S.E.11.

In the accompanying figure is shown a section through a typical work-head spindle for one of the company's machines and it may be noted that a Talyrond test of a 3·4-in. diameter bore ground on one of these spindles showed a maximum deviation from true circularity of only 0·4 micron (0·000016 in.). A Perth-o-Meter was used to measure the surface finish of the same bore, and an r.m.s. value of 0·03 micron (1·2 micro inches) was obtained.

For the machine on which the spindle is employed a nose bearing diameter of about 3⅞ in. would normally be considered adequate, but to provide greater stiffness this dimension has been increased to 4$\frac{7}{16}$ in. At the nose end, a double-row cylindrical roller bearing is employed, of the type which has a tapered bore. With such a bearing, the inner race can be moved axially on the tapered portion of the shaft to obtain a slight expansion. By carefully controlling this adjustment, radial play can virtually be eliminated from the bearing, while leaving it free to rotate without generating excessive heat in service.

The standard outer race for this bearing is not used. Instead, a comparatively thin-section hardened steel ring is fitted in the work-head casting, and is retained in position by a conventional cap, which also serves as a labyrinth-type oil seal. At the rear of the spindle there are two high-precision ball journal bearings, which provide axial location and are pre-loaded. By means of the nut *A*, at the rear end of the spindle, the inner races of these two bearings are thrust to the right, and this force is transferred, by way of short and long spacers, to the inner race of the nose bearing. All the component parts in this portion are thus locked as a unit.

At the rear of the spindle housing there is a cap *B* which has a threaded bore. In engagement with this bore there is another adjusting nut, indicated at *C*, and when this member is turned thrust is applied to the outer race of the left-hand ball journal bearing. With this arrangement, a predetermined pre-load is applied to the ball bearing assembly, and axial play is eliminated.



Section through a typical work-spindle of a Wotan internal grinding machine, showing the anti-friction bearing arrangements. A 3·4-in. diameter bore ground with the aid of this type of spindle had a maximum deviation from true circularity of only 0·4 micron (0·000016 in.)

Stores Control System for Bought-out Parts

Aspects of the Procedure Employed by Corran Works, Ltd., for Controlling the Receipt, Storage and Issue of a Wide Variety of Bought-out Radio Components

By A. W. ASTROP, Associate Editor

AT THE TIME OF A RECENT VISIT to Corran Works, Ltd., a member company of the Pye Group, at Larne, Northern Ireland, 24 different types of radio sets were being assembled, in large quantities, including domestic, pocket, and cabinet models, and during peak periods as many as 34 different types of sets have been in progress at one time. In an article in MACHINERY, 98/1313—7/6/61, attention was drawn to some aspects of the assembly methods and equipment employed. Apart from the manufacture of certain types of coils, tuning dials, and printed circuit boards, the factory is devoted entirely to the assembly of radio sets from bought-out parts, and to the collating and packaging of complete kits of parts, for subsequent assembly outside the works.

It will be appreciated that with a range of different types of sets, each of which is being assembled in batch quantities ranging from 500 to 1,000, the tasks of ordering bought-out parts, ensuring the maintenance of delivery dates quoted by the suppliers, checking goods received for type and quantity, and storing the parts so that they can readily be located and delivered to the shop floor, presents formidable problems. In this connection it may be mentioned that at the time of our visit, the number of different bought-out items for which Corran part numbers were allocated was 4,500, and that this total did not include all the different types and lengths of pre-cut and stripped wires and flexes which are required.

The buying office of the company has a staff of eight, and in addition there are eight supply clerks whose duties comprise maintaining continuous liaison between the company and its suppliers. For convenience, the bought-out parts buying list for any particular set is always based on a batch quantity of 1,000, although the actual rate per week at which a set is assembled is specified by the main sales organization, and is largely regulated by demand, or anticipated demand. With this information available, the purchasing department can specify the total number of any particular part required, when the order is placed with an outside supplier, and can also specify the rate per week at which the parts are to be delivered.

In the "goods inward" department of the company, the incoming packages are opened and checked against the company's order to ensure that the supplier has forwarded the correct material and has quoted the correct part number. If this information is correct, and the goods are acceptable in all other respects, certain information is entered on a special card of the form indicated in Fig. 1, which is perforated across the middle.

The printing and columns seen on the bottom portion of the card in Fig. 1 are repeated on the opposite side of the upper portion, so that when the card is torn in half, two identical printed portions are obtained. In the goods inward department, the Corran Works part number is written in the top left-hand box, and the description of the part—for example, resistor, 27K ±20 per cent—is written in the box immediately beneath. The total number specified on the works order is written in the box headed "quantity," and the type of set for which it is required in the adjacent box. The last box in this line is used to record the day, month, and year of receipt. Next, the complete card is stapled by one edge to the

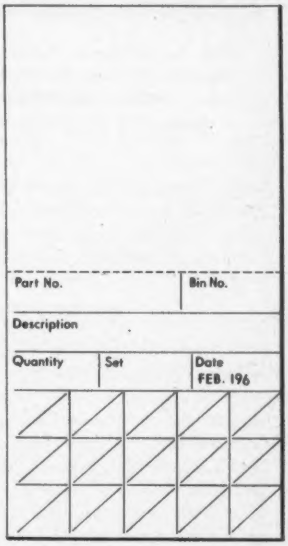


Fig. 1. Filing card employed by Corran Works, Ltd., for their "random" storage system for radio components. The system provides for the receipt, storage, and issue of 4,500 different types of components, in large batch quantities

Fig. 2. A typical storage rack is here shown, with one of the desks in which the record cards of stored components are filed. Parts trays are inserted in the racks at random, to ensure even distribution and efficient utilization of the area

front of a standard wooden tray in which the parts are passed to the stores. It should be mentioned here that the cards are printed in six different colours, the reason for which will be explained later.

WOODEN STORAGE RACKS

In the storage area there are 26 double-sided wooden racks, of the type shown in Fig. 2, and each is alloted a letter from the alphabet. Each side of the rack is divided into 18 vertical sections, lettered from A to R, and each vertical section is divided into 18 compartments, which are numbered from the top downwards. On one side the compartments are numbered from 1 to 18, and on the other, from 19 to 36. The letters from A to R for the vertical rows are painted on the floor, as can be seen at the right-hand side of the rack in Fig. 2, and the other side is similarly lettered. Numbers for the separate compartments are stencilled on the end of the rack, as seen in the figure.

At the ends of certain racks there are sloping desks with numbers of compartments of a size to suit one half of the card shown in Fig. 1. Each desk has a hinged lid, which can be lowered to the compartments, and locked. It is retained in the open position by swivelling latches on a wooden slat screwed to the end wall of the rack. The arrangement is such that each desk is devoted to a certain group of Corran Works part numbers, and the lowest and highest numbers of the group are shown on a card secured above the desk. The card for the rack seen in Fig. 2 (rack C) is secured just below the lamp bulb, and relates to part numbers between 830000 and 490000.

Taller cards, bearing the various part numbers in the group, are provided, and serve to separate the various groups of cards filed in the desk. There is not necessarily any connection between the cards filed in a desk and the contents of the rack to which it is attached. For example, while the desk shown in Fig. 2 is devoted to part numbers between 830000 and 490000, it would be entirely fortuitous if any components with numbers within that group were stored in rack *C*.

When a tray is delivered from the goods inwards department it has a complete card (as shown in Fig. 1) stapled to one end. This tray is taken by one of the stores staff and is inserted in the first vacant compartment in any rack. The location of the compartment is entered in the box headed Bin No. on each side of the card. The free portion of the card is then torn off, at the perforations, and is taken by the store keeper to the appropriate filing desk, in accordance with the part number of the components which have just been stored. With this arrangement, a tray of components bearing the part No. 411000 might be stored in compartment 11, row K, of rack P. The card, however, would then be filed in the desk seen attached to rack C in Fig. 2, since this desk covers the group of part numbers which includes 411000.

When the card is filed in the appropriate section, other cards bearing the same part No. may already be in position. These cards relate to additional trays, of the same type of component, which are filed in other racks. In practice, it should be mentioned, certain of the racks are reserved for certain types of components, for example screws, shake-proof washers and similar items are always stored in a rack at the end of the line. In general, however, the bulk of the

trays of components received from the goods inwards department are inserted in compartments at random, as described above.

ISSUING PARTS

When the works receive an order from the sales department for a batch of radio sets of a particular type to be assembled, a parts list is made out and is issued to the stores. The batch quantity is quoted, as are the individual part numbers of all the components which will be required to complete the set. One of these lists is seen at *A* in Fig. 2, and the store-keeper places it on a flat board where it is supported by a small ledge. The board is rebated at the top and bottom edges, on the under-side, so that is fits within the opening of the desk and can readily be slid to the left or right to uncover the cards as required.

At the desk shown in the figure, the storekeeper will scan the parts list for any component numbers within the group 830000 to 490000, and will refer to the appropriate cards in turn. The information concerning the bin location of each component—and the number of components in that particular tray—is then written on the parts list, and this procedure is repeated, at each desk, until the parts list has been completed. If the number of parts recorded on the card for one bin location is insufficient for the requirements of the parts list, then the next card is withdrawn, to provide for the balance. With this arrangement, the bin locations for, perhaps, three trays may be written on the parts list against a particular component number, in order to cover the total quantity required. It will be recalled that mention was made earlier of the use of cards of six different colours. These colours represent the six months from January to June inclusive, and serve to ensure that the stored components are withdrawn in the correct chronological order. The store-keepers know the colour sequence of the cards, and will always select the "oldest" bin location first. Ideally, the purchasing department endeavours to maintain stock for six weeks' work, so that no component is stored for longer than that period. The coloured cards also provide an easy visual check of the age of the trays in the racks. Since one half of each record card is attached to a tray, a blue card (representing January, for example) is obviously out of place on a tray in April, for which the colour may be red. An investigation is then carried out to determine whether that particular tray has been overlooked, or whether the particular component has been over-ordered. At the end of June, the colours of the cards are automatically allocated to July to December inclusive.

When a tray has been emptied of components, the card is removed from the front edge and is taken to the appropriate filing desk from which the other half is taken. The two halves are then placed in a special compartment, at one corner of the desk, which is regularly emptied, and the cards are retained for a certain period, after which they are destroyed. Empty trays are returned to the goods inward department. When a tray is out of its rack for removal of the required number of components, a flat sheet of aluminium, with one edge turned over, is inserted in the empty compartment, as an indication that a tray has been removed but will be returned. With this arrangement, fresh trays from the goods inward department are not inserted in compartments which are only empty temporarily.

Referring again to Fig. 1, it will be seen that the bottom half of the printed portion of the card has a number of squares, each divided diagonally. Each time a quantity of components is withdrawn from a tray the appropriate number is written in one of the squares. Running totals are kept on the backs of the cards, and with this arrangement the actual contents of any tray can readily be determined without going to the rack in which it is stored.

SOME ADVANTAGES OF THE SYSTEM

In this article it has only been possible to give a broad general outline of the system, and the salient points in connection with its operation. Since it was installed, however, the company has been able to exercise a much closer and more effective control over the numbers of components under order, in stock, and issued to supervisors on the shop floor.

The actual quantity in store at any one time has been reduced to the minimum required to ensure a continuous supply to the assembly benches, with only a small surplus for contingencies. From a security standpoint, it is almost impossible for any unauthorized person to withdraw components from stores, for the reason that, without access to the filing desks, a bin location cannot be discovered. During working hours, when the filing desks are open, stores staff only are allowed in the rack area, and at the end of a shift the filing desks are locked and the keys are returned to the head store-keeper.

In addition, the system has enabled the area available for storage to be utilized much more efficiently. Since the trays are stored at random, they are always evenly distributed throughout the area, and local congestion is impossible. With the previous arrangement, attempts were made to store similar components in selected areas, with the result that certain parts of the stores were heavily con-

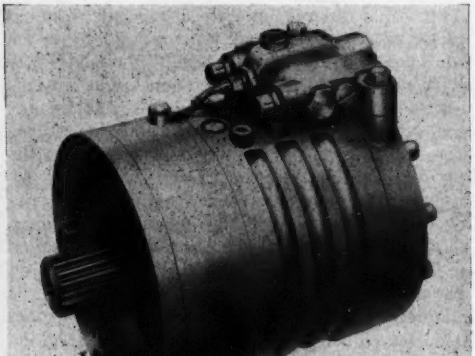
gested, whereas others were used less effectively. Changes in stock quantities, as a result of fluctuating demand or the introduction of new designs of products, involved frequent re-arrangement of the stores area, and the difficulties of ensuring that components were used in date order were considerable.

The company acknowledges the assistance and advice, in devising this system, to suit the quantities and types of components to be stored, which was obtained as a result of consultation with Fisher & Ludlow, Ltd., Material Handling Division, Bordesley Works, Birmingham, 12, and with Mr. L. J. Hoefkens of the Lockheed Hydraulic Brake Co., Ltd.

Dowty Hydraulic Rotary Actuator

Dowty Hydraulic Units, Ltd., Aschurch, Glos.—a member company of the Dowty Group—have recently introduced the hydraulic rotary actuator shown in the figure. Of the single vane type, this unit is designed for operation by fluid at 1,000 lb. per sq. in. pressure, and has a starting torque of 2,200 lb.-ft. A torque of 2,800 lb. ft. can be transmitted when the unit is in operation, and the output shaft can be turned through a maximum angle of 200 deg., under the control of stops which are provided by the user.

A relief valve can be mounted on the body for controlling pressure due to inertia loads, and for directing pressure fluid to the return line in the hydraulic system when the shaft has been arrested by a stop. The single moving vane and the fixed vane are secured, respectively, to the shaft and the body by bolts and dowels, and D-section rubber oil seals and leather anti-extrusion rings are fitted. Two sets of O-ring seals and anti-extrusion rings are provided at each end of the output shaft.



The new Dowty hydraulic rotary actuator

B.S.A. Burr-Bit De-burring Tool

Made by B.S.A. Small Tools, Ltd., Montgomery Street, Sparkbrook, Birmingham, 11, the Burr-Bit is intended for deburring the edges of threaded holes while tapping is in progress, and incorporates a ring-shaped cutter body, which can be passed along the tap and is positively driven by internal projections that engage the flanks of the flutes. Cutter teeth are provided at the lower end of this body, which is connected to, and urged away from, an upper collar by a spring. By means of a screw in this collar, the unit is secured to the shank of the tap in such a position that the ends of the cutter teeth are slightly above the first full thread, as can be observed clearly in the accompanying figure.

For de-burring threaded holes during tapping, the B.S.A. Burr - Bit is mounted on the tap, as here shown

In use, the cutter teeth, which extend radially into the flutes, are engaged with the upper edge of the hole at an early stage in the tapping stroke. Further feeding serves to compress the spring, and the pressure thus applied enables the burr to be removed after the tap has been reversed, for withdrawal. In this way, a smooth thread lead is obtained, and the cuttings are prevented from entering the hole. Only a small chamfer is formed so that the effective lengths of threaded holes which are tapped in thin materials are not significantly reduced.

Units are available in two types and a range of sizes, to suit 2- or 4-flute and 3-flute taps from 6 B.A. to ¾ in., and a double conical spring can be supplied for use when tapping deep holes.

The New Alfred Herbert Research Department

THE NEW APPLIED RESEARCH DEPARTMENT at the main works of Alfred Herbert, Ltd., Coventry, was officially opened by the Rt. Hon. Reginald Maudling, M.P., President of the Board of Trade, on June 20, and affords ample evidence of the importance which is rightly attached by the company to this aspect of a machine tool builder's activities. Although it can be reasonably stated that all machine tools are variations on a limited number of basic types, it is now more necessary that ever to ensure that such design-variations afford the shortest operating and setting times, minimum tooling costs, and maximum precision, if they are to meet the increasingly exacting demands of users both at home and overseas. Such demands cannot be satisfied by rule-of-thumb methods of design, or the leisurely development of machines as the result of experience gained from their use in the field over a number of years. Moreover, competition in the machine tool industry, on a world scale, is now so keen, that the builder must constantly be on the look-out for developments in applied science or technology, which may offer possibilities for the improvement of his products.

It may be of interest to mention that the first laboratory was established at the Herbert works in 1910, and when the new design wing was built in 1958, it was planned to erect a new building to house the research department of the company on an adjacent plot of land. It is intended that the department shall integrate, extend, and control the mechanical and electrical development work of the company as a whole, and its work will be closely linked with that of the separately housed and staffed physical and chemical laboratories, and A.I.D.-approved measuring department. Facilities in the new building provide for the construction of prototype machines and for testing developments and new ideas associated with production engineering.

Constructed of brick, the building has been designed to provide maximum natural light without excessive temperature variations. It is therefore illuminated by north-facing roof-lights and windows on the north-east side of the main hall. This hall houses the Mechanical Section, and is divided into two bays, each served by a 15-ton overhead travelling crane, a view in one of the bays being given in Fig. 1. Equipped as a machine shop, this bay provides for the production of components for prototype machine tools (only the larger elements will be machined in the production shops of the Coventry works), parts needed for the development of existing machines, and jigs, fixtures, models and other equipment for the applied research projects of the department.

The second bay, part of which is seen in Fig. 2, serves for the erection of prototype machines, also for subsequent testing and operation under controlled conditions. In the concrete floor are embedded six 8½-in. deep, T-slotted load-bearing

Fig. 1. Part of the Mechanical Section of the new Herbert Applied Research Department, equipped for building prototype machines, also tools and fixtures for research investigations

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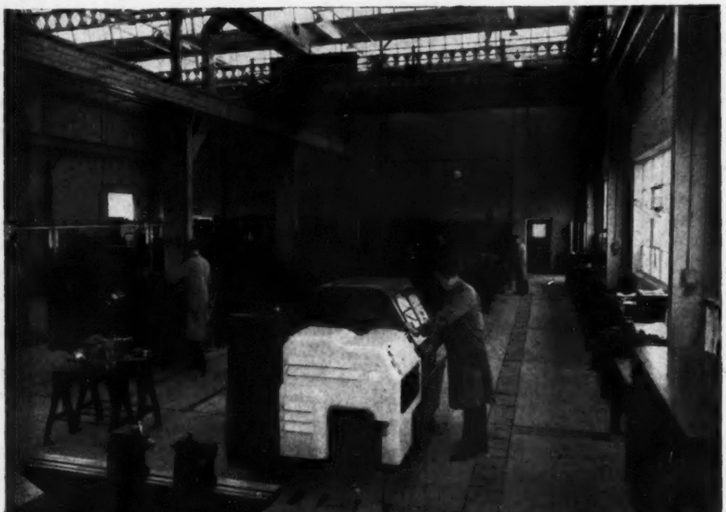

Fig. 2. The erection shop and test bay of the Mechanical Section. Machines under test can be bolted to cast iron channels in the floor, or mounted on an insulated concrete raft

members of cast iron, each of which is 40 ft. long. These members provide for mounting machine tools under test, and have been accurately levelled over their length and with respect to each other. A concrete raft, insulated from the surrounding floor, serves as a foundation for the precision testing of the more-sensitive types of machines. A variety of electrical supplies is available at a large number of outlet points covering the whole of the machine testing area, and connections can be made to remote reading instruments and equipment in the Electrical Laboratory of the department, by way of covered channels in the floor.

The Electrical Laboratory is housed in a separate section at the end of the building. It has been specifically equipped to cater for machine tool research and development, and the solution of related problems. A wide range of electrical supplies is available, and equipment is installed for the precision measurement of electrical and physical phenomena. Facilities available provide, for example, for wave-form analysis, high-speed counting and timing, process measurement and control, and temperature measurement.

On the opening day, many of the latest Herbert developments were not on view, but a comprehensive range of machines, test rigs, and experimental set-ups was displayed, and some examples are shown in the illustrations on pp. 1436 and 1437. About one-third of the exhibits in the Mechanical Section comprised complete machines of improved productive capacity on which work is at present in progress. Among such machines may be mentioned a prototype No. 7 Preopticop lathe which has been designed to provide for the production of small quantities of parts, with special emphasis on ease of setting. Two profiling slides are fitted to enable longitudinal and transverse copy-machining to be performed, and facilities are provided for the rapid change-over of templates and tool-holders. In addition to normal turning tools, it is possible to use boring tools, drills and reamers on this machine. Patented Lamalock clamping of the saddle, it is stated, enables it to be accurately positioned, so that components can be repeatedly produced to close tolerances. The clutches for rapid longitudinal power traverse are hydraulically operated, and the machine, which is not yet in its final form, incorporates as many standard components as possible.

A No. 4 Major capstan lathe on view has been employed as a test rig for investigations concerned with machine programme control. On this machine, all headstock speed changes are effected by magnetic clutches, controlled from static switches, and the feed drive is independent of the spindle, synchronization being provided by a Pye TASC clutch-coupling, with feed-back control. The clutch-coupling must cater for a very wide range of speeds, since at any one setting of the feed rate, it has to ensure synchronism with the spindle in order to maintain a constant chip thickness. Regulation of feed rate within close limits, and rapid response with freedom from oscillation, are essential. A tacho-generator associated with the spindle provides a speed signal, and the basic feed rate per rev. is pre-set by means of a potentiometer. Feed rate is then automatically varied in response to variations in spindle speed.

On another experimental, programme-controlled, capstan lathe, work is being carried out on methods of stopping lathe spindles at predetermined angular positions, in order to facilitate loading or the insertion of a power-operated chuck key. The specially-developed electrical control gear incorporates a proximity unit for single-position sensing, and a low-frequency a.c. converter for rotating the spindle at very slow speeds.

A prototype No. 2 Programme Auto was shown, which is arranged for punched-card control, and has been so designed as to isolate the clean and dirty areas of the machine, as far as possible, when coolant is used. This machine has electronically-controlled screw-feed motions, driven independently of the headstock, and controlled by limit switches. Special provisions have been made to ensure accuracy of functioning throughout a very wide range of feed rates and loads. Independent motors are provided for the speed, feed and rapid traverse drives, and the spindle is driven by chains to isolate it from heat-producing units such as gears and clutches. An angular profiling slide is mounted on the turret.

Mention may also be made of a No. 9C cross-sliding turret lathe with a special test headstock embodying magnetic clutches. Lamalock clamping is provided for the turret and slides on this machine, and the turret location plunger withdrawal and quick-power traverse motion are hydraulically operated. Adjacent to this machine was a turret test rig for assessing the merits of various clamping arrangements for lathe turrets.

Other equipment seen in the mechanical section included a power-operated chuck wrench incorporating a torque gauge; a skeleton headstock for investigations relating to the efficiency of spindle bearings, which was fitted with an assembly comprising pre-loaded needle bearings for journal loads and angular contact bearings with floating outer races for thrust loads; a drilling machine speed-gearbox test rig for investigations of gear materials and different gear hardening treatments; an electric clutch test rig for checking torque capacity and plate wear; a test rig for investigations of air-flotation slides; models for determining the most effective lathe bed designs for resisting heavy torque loads; equipment for measuring the torque when producing threads by tapping, die-cutting, and rolling; and new types of Microbore units which can be pre-set independently of the clamping pressure imposed by different operators.

Part of the Electrical Laboratory of the Applied Research Department is seen in Fig. 3, and in this section there were many interesting examples of development work that is being carried out. Static switching, which was demonstrated, has been designed by the company specifically for machine tool applications, with lower-power elements for interlocking and memory functions. A low-cost transistorized timer for use on injection moulding machines was shown. This unit covers a range from 1 to 100 sec., with an accuracy of ±2 per cent, and repeatability is ±2 per cent over a temperature range of 40 to 120 deg. F.

A positioning table for a drilling machine was exhibited, which incorporates an air-flotation slide. With this unit, feed-back information is supplied from synchro-resolvers on screws that operate in ball-circulating nuts. Tape control is provided and static switching is employed for the motor

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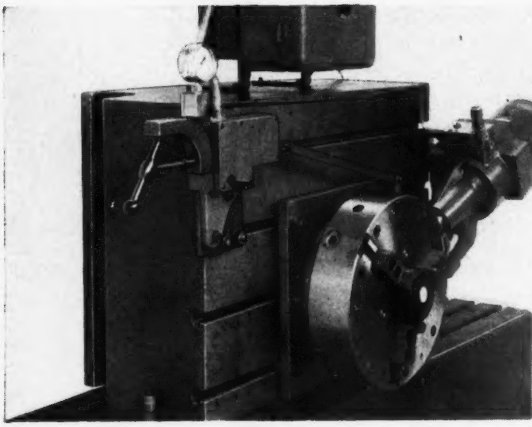
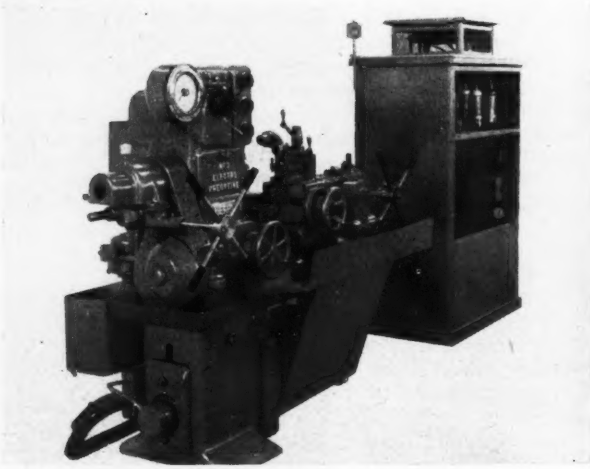
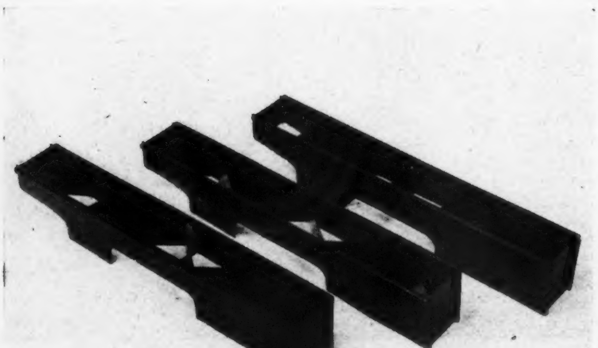
Fig. 3. The Electrical Laboratory of the Herbert Applied Research Department. Investigations into electrical controls for machine tools are carried out, and new components and complete systems developed



A power chuck wrench, developed by Alfred Herbert, Ltd., facilitates operation of the company's Coventry chucks, without imposing any restriction on the bore of the associated spindle. A torque gauge incorporated in the unit indicates the gripping force applied, which is controlled by the slipping of a magnetic clutch, adjusted by means of a potentiometer. The company has also developed mechanism whereby a lathe spindle can be stopped in a predetermined position for entry of the chuck wrench key

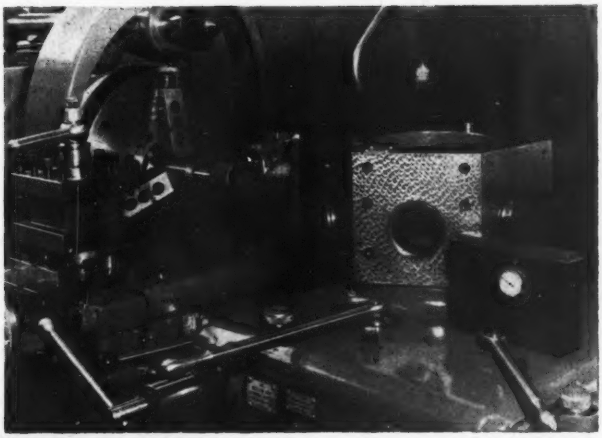


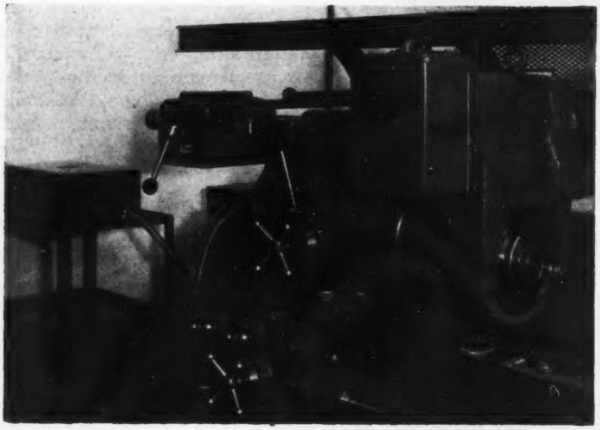
This No. 3 Electro-Preoptive capstan lathe, built in 1947, was displayed in the new Applied Research Department of Alfred Herbert, Ltd. It is fitted with a variable speed a.c. motor, with thyratron control, and the output speeds range from 60 to 1,500 r.p.m. at constant torque, and from 1,500 to 3,000 r.p.m. at constant horse-power. Speeds can be set on dials and obtained instantly when required. The machine was used in connection with the development of the steplessly-variable speed drives for the 49V and 28A milling machines



These models were used in the Mechanical Section of the Applied Research Department to demonstrate the relative differences in rigidity of lathe beds with various systems of cross bracing, each designed to afford ample clearance for the disposal of swarf between the bedways. In the foreground is seen the model of the current heavy-duty lathe bed, which is considered to provide optimum rigidity in all directions, yet present a free passage for the escape of swarf

Set-up on a Herbert No. 9C combination turret lathe for the measurement of the torque required for tapping threads of different sizes in a range of work materials. The tap is carried in a spindle that passes through the hexagonal turret of the machine. A torque arm, at the end of the spindle remote from the tap, rests on a beam of predetermined length that is freely supported at both ends. Deflection of the beam is measured and indicates the load on the torque arm, from which the actual tapping torque can be determined





An electrically-operated chuck for bar work, which has been developed by Alfred Herbert, Ltd., and is designed to impose no restriction on the lathe spindle bore. The powerful grip is obtained by an electric stator-rotor unit, from which drive is transmitted, through a reduction gear, a crank-operated lever mechanism and a toggle system, to a collet. This equipment is at present being subjected to an endurance test, and after several thousand operating cycles, it will be dismantled and examined for signs of potential failure

Static switching, based on known principles, is being developed in the Electrical Laboratory of the Herbert Applied Research Department specially for machine tool control. The system is primarily intended for switching operations in connection with the control of output units of considerable size. Where necessary, low-power equipment is used to provide for interlocking and "memory" functions. "Logic" control of the system is provided by limit switches, pressure switches, and other units on the machine

(*Continued from page* 1435)

control system. The object has been to produce a relatively cheap unit with accuracy of co-ordinate positioning to $\pm 0{\cdot}001$ in.

A multi-station shuttle type conveyor was shown, which has been developed for use with automatic transfer and loading arrangements for machine tools. Although there is no physical contact with the components, this unit "remembers" the component positions, and correct sequencing is obtained by means of a special counting system.

Attention may be drawn to a magnetic-tape sequence control system, which is stated to be the first of its type developed in the United Kingdom by a machine tool builder. Of the tone multiplex type, it is intended for use with machine tools which rely on the use of dead-stops for accurate positioning. During initial setting up, six frequencies, generated by resistance capacity oscillators, are fed singly, or in selected combinations, to six tuned-reed relays, each of which is adjusted to respond only to one of the frequencies. Slave relays, operated by the tuned-reed units, then control the machine motions. While the first component is being produced, the frequencies are recorded in the correct sequence on a single-channel magnetic tape. Subsequently, the tape is used to repeat the programme automatically.

Other equipment on view in the Electrical Laboratory included a simple variable-speed d.c. drive system incorporating silicon-controlled rectifiers, with speed variation of ± 5 per cent between no-load and full-load running; a small scale model of a d.c. linear motor; a low-voltage induction heating unit for an injection moulding machine; and a rotating-type indexing reader developed for punched-card programming systems.

Adjacent to the Electrical Laboratory, office accommodation is provided for the mechanical and electrical research staff. It may be mentioned here that the qualified engineers engaged on applied research and development represent 0·5 per cent of the total staff of the company and its subsidiaries, and the qualified engineers engaged in design work, 4 per cent.

I.B.M. Data Processing Centre

The amount of data processing work which is necessary to justify the installation of a very large computer is such that comparatively few organizations are able to take advantage of the low job-costs that can be achieved with these machines. To enable companies of all sizes to have access to the facilities offered by large computers, I.B.M. United Kingdom, Ltd., have opened a Data Centre at 58-62 Newman Street, London, W.1.

At this centre, commercial and scientific organizations can write their own computer programmes and can operate the machines themselves under the guidance of I.B.M. staff. The user pays only for the time that the computer is being employed on the problem in hand.

If a firm decides that the Data Centre can be of service, members of the staff are first sent to the Centre for a programming course, of a maximum of four weeks' duration. No charge is made for these courses and attendance does not make it obligatory for the firm to use the facilities of the Centre if a detailed study of the proposed application shows that it is not a suitable subject. After attending a programming course, the staff of a firm continue to have the benefit of advice from the Data Centre specialists during subsequent use of the computer. It is explained that the customer can learn data processing techniques more easily than he can teach the I.B.M. specialist programmers the intricacies of his own accounting procedures or scientific calculations, for instance.

The Centre is equipped with I.B.M. type 7090 and 1401 integrated data processing systems, and it is stated that the type 7090 fully-transistorized computer is the most powerful in general service.

European Machine Tool Exhibition

At the 7th European Machine Tool Exhibition to be held in Brussels from September 3 to 12, there will be 4,000 machine tools on view with an aggregate weight of 15,000 tons. Other exhibits will include small tools, accessories, and machine tool attachments; instruments and apparatus for measuring, controlling, and checking; testing machines; welding equipment; and heat and surface treatment equipment. Stands will occupy an area of 495,000 sq. ft. and there will be 762 exhibitors from the following countries: Austria (13), Belgium (38), Denmark (5), France (145), Germany (Federal Republic and West Berlin) (280), Holland (21), Italy (87), Sweden (17), Switzerland (91), and the United Kingdom (65).

Catalogues (price 100 Belgian francs for despatch within Europe, and 150 Belgian francs for air despatch outside Europe) will be available from July onwards. Payment should be made to account No. A 26/1617 of the Commissariat General de la 7 ème Exposition Européenne de la Machine-Outil, 13 rue des Drapiers, Brussels 5, at the Banque de Bruxelles, Brussels. An advice note of this payment should be sent to the Commissariat General giving the forwarding address.

Room reservations are handled by the agencies of Wagons-Lits/Cook, Wagons-Lits, and Thos. Cook & Son, Ltd.

NEWS OF THE INDUSTRY

Yorkshire

CHURCHILL REDMAN, LTD., Parkinson Lane, Halifax, report continued increases in the demand for their range of standard centre lathes—special reference being made to the number of Cub lathes at present on order; P.5. automatic multi-tool profiling lathes; Churchill-Fay multi-tool lathes; centring and facing machines; and link-line work-handling and loading equipment. The demand for shaping machines has shown little improvement over recent months, but orders are in hand for a number of these machines of the standard, mechanically-operated type.

This company recently held a 14-day exhibition in the London showrooms of Charles Churchill & Co., Ltd., and machines have also been exhibited in Sweden. Current export markets include Australia, Portugal, Sweden and Spain.

We are informed that all standard centre lathes built by this company, with the exception of the Cub, are now available with profiling equipment, which is made at the Halifax works.

The company is also undertaking the manufacture of chucks, chip-conveyor systems, transfer units and work-handling equipment for their machines, and developments of the P.5. automatic multi-tool profiling lathe, at present in hand, include a prototype 816. P.5 model, of which it is hoped to publish details at a later date.

AUGUSTS, LTD., Exmoor Street, Parkinson Lane, Halifax, are engaged in the production of their range of foundry equipment, including sand drying, scrubbing, preparing and distribution units and mould conveyors. Units recently added to the range include newly-designed American equipment, made under licence, among which may be mentioned August-National sand recovery machines, pneumatically-operated sand transportation units, and hydro-filter clean air machines, also August-Simpson Multi-Mull continuous mulling machines.

P. M. WALKER & CO. (HALIFAX), LTD., Alexandra Works, Hopwood Lane, Halifax, manufacturers of air heaters, dust collection and air conditioning units, electric fans, and humidifying units, have recently completed an installation of air conditioning plant in Belfast, valued at £100,000. The plant comprises humidifiers, refrigerator and heating units, and filtration and

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Built at a cost of £2,500,000, a new single-strand continuous plant for the production of self-fluxing sinter has recently been put into operation by the Workington Iron & Steel Co., Moss Bay, Workington, Cumberland. In the accompanying figure is shown a general view of the 6-ft. wide by 180-ft. long sintering machine which provides for carrying the raw materials beneath the ignition hood seen in the background at speeds between 45 and 170 in. per min. Measuring 6 ft. 2 in. long by 7 ft. 8 in. wide, the ignition hood has an air blower which is rated at 2,500 cu. ft. per min., at 12 in. water gauge. The plant is capable of producing 12,500 tons of sinter per week

air washing equipment. The whole installation is required to control temperature and humidity to very close limits. The works are now engaged on a large contract for ventilation equipment, which will be installed in the new atomic power station at Trawsfynnydd.

A number of new machines has recently been added to the plant, including press brakes, guillotine shearing machines and plate bending rolls, and the works staff has been increased. This company now carries stocks of propeller fans ranging from 12 to 36 in. diameter, including units with special motors for operation in saturated atmospheres.

BENCHMASTER MACHINE TOOLS, LTD., Well Lane, Halifax, inform us that the demand for their range of equipment, including the Benchmaster high-speed metal-sawing machine, is maintained at a high level.

SAMAND ENGINEERING, LTD., Water Lane, Halifax, are fully occupied with the production of their range of grinding and lapping machines for tungsten-carbide tipped tools, for which a number of export orders is now in hand from Canada and New Zealand. A certain amount of development work is being undertaken, and we hope to publish details at a later date.

JOHN MITCHELL & CO. (HALIFAX), LTD., Godley Road, Halifax, inform us that home and export orders for the standard 8½-in. centre lathe are being maintained at a steady level. This company is also experiencing an increasing demand for special types of machines.

GEORGE SWIFT & SONS, LTD., Claremount, Halifax, inform us that the recent increase in demand for all sizes and types of lathes is being sustained. Machines now being built in the works, in addition to the smaller standard types of lathes, include two 30-in. centre lathes with faceplate-drive headstocks. Each machine has a long, jointed bed, one being 49 ft. and the other 40-ft. long. Among other machines, may be mentioned a special crankshaft profiling lathe with a 17-ft. 6-in. long bed; a 21-in. centre lathe for India; and a number of surfacing and boring lathes, of 16½-in. centre height, which are similar to the company's 16S.C. type, but with slight modifications to suit the special requirements of the customer. This company has recently manufactured a special profiling lathe for operations on turbine casing units, and it is hoped to publish full details of this machine at a later date.

STANLEY MACHINE TOOL CO., LTD., New Bank, Halifax, report a continued improvement in the demand for their range of standard centre lathes, and a satisfactory volume of orders is being received for sliding-bed lathes. The call for special machines has shown a marked increase during the past few months, and a large proportion of current orders, for machines of all types, is for the export market.

PRINCE & BROWN CO., LTD., Baxter Lane, Northowram, Halifax, report that they are very busy with the manufacture of small special-purpose grinding machines. This company also manufactures jigs, fixtures and special tooling to suit the individual requirements of customer firms and a considerable amount of contract machining work for the aircraft industry is being undertaken at the present time.

S. APPLEYARD & CO., LTD., Grantham Road, Boothtown, Halifax, report that orders for their punching and shearing machines, shear blades, punches and dies, are increasing, and the company is to build a number of single-ended punching and shearing machines, with angle cropping units, for export to Iraq. A steady demand is being made on the facilities of the company's service department, which undertakes the repair and renovation of all types of sheet-metal working machinery.

PORTLAND ENGINEERING CO., LTD., Eastfield Mills, Horley Street, Claremount, Halifax, report a continued call on their services as fabrication specialists from the agricultural and earth-moving machinery, and tractor manufacturing industries. Among the company's own products may be mentioned stainless steel sink units and steaming ovens for industrial use, sterilizing equipment, and dyeing vessels, and these units are in good demand. This company also undertakes argon-arc welding and profile cutting in all thicknesses of stainless steel, on a contract basis, for other companies in the area.

THE YORKSHIRE DIE-CASTING CO., LTD., Ashday Works, Brighouse Road, Elland, report an increasing call for die castings for a variety of purposes from a wide range of industries. This company is authorized to apply the B.S.I. mark to zinc-base alloy die castings, and, at present, is equipped to produce such castings up to a maximum unit weight of 5 lb., also aluminium alloy gravity die castings up to a maximum unit weight of 12 lb. A new cold chamber aluminium pressure die casting machine, type E.M.B.12, has recently been added to the plant, in order to handle the increasing volume of work.

CALDER ENGINEERING CO., LTD., 370 Bradford

Road, Brighouse, inform us that in addition to producing rolls for photogravure printing and for use in the textile and chemical industries, they are now executing a number of important contracts for the rolls for steel strip mills. In order to meet the increasing demand for its services as a specialist roll manufacturer, this company has initiated an expansion programme in the roll department. Among new equipment so far installed may be mentioned a Dean, Smith & Grace lathe, of 36-in. diameter swing and admitting 24 ft. between the centres, and a Churchill roll grinding machine with capacity for work up to 24 in. diameter by 24 ft. long. A new 10-ton capacity crane has also been installed, to facilitate handling rolls of larger dimensions that are now required. Other activities of this company include the manufacture of single-throw crankshafts, for which there is a good demand from export markets.

R. SUTCLIFFE.

The South

NORWOOD (PRECISION PRODUCTS), LTD., Cornwallis Avenue, Gillingham, Kent, are A.I.D.-approved, and undertake a variety of sub-contract work for the electronics and electric-lamp industries. During recent months there has been a steady increase in orders and a night-shift is being worked. In collaboration with the associated Northern Industrial Designs, Ltd., of the same address, the company is carrying out design and development work on filament-cutting machines for electric light bulbs and on special machines for assembling glasses on to the brass caps of motor-vehicle bulbs. Components for diesel engine fuel pumps are also made, and another product is the Norwood precision clamp, for securing work to the tables of machine tools.

Recently, the company has acquired the sole manufacturing rights in the United Kingdom and the Commonwealth of the Nobal ball joint. Of Swiss design, the joint is to be made in eight sizes with static load capacities from 330 to 3,500 lb. The ball is of a plastics material which obviates the need for lubrication. Rotary movement is permitted at angles up to 18 deg. from the central position, and the joint can be supplied with a tie-rod type end, for direct connection to a forked member.

STARTRITE MACHINE TOOLS, LIMITED, Star Mill Lane, Gillingham, inform us that they are still experiencing a substantial demand for bandsawing machines, notably for those of European make sold under the names of Metalin, Meba, Wespa and Habegger. A large stock of bandsaw blade coils in various widths up to 1 in. is maintained, and customers may be supplied at short notice—usually by return post—with endless loops of any required length. Another service, of which increasing advantage is being taken, provides for the test cutting of customers' bar stock on pre-set automatic bandsawing machines, to establish production rates obtainable with different materials and to provide data relating to blade performance.

ABWOOD MACHINE TOOLS, LTD., Princes Road, Dartford, Kent, report a sustained demand for their surface grinding machines, which are built for manual or hydraulic operation and may be employed with cutter grinding attachments; circular dividing machines; grinding and lapping machines for cemented carbide tipped tools; machine vices; and compound angle tables. From the home market, orders have been received recently for Abwood auto-cycling high-production grinding machines, which are to be employed for the production of parts for automobiles. The company is also active in the export field, and in this connection Abwood machine tools are

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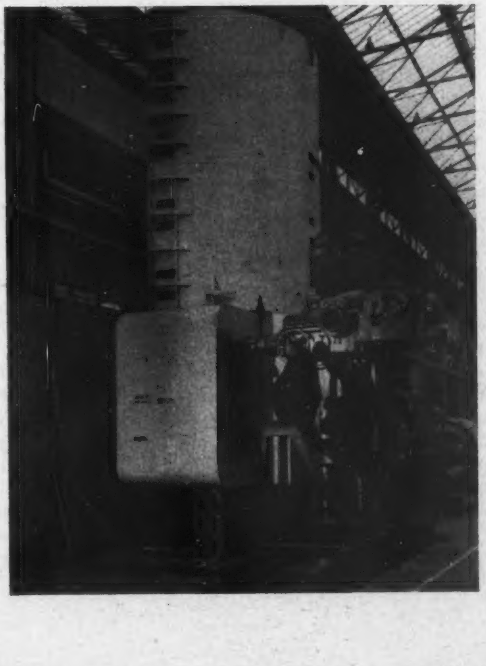
A milling operation is here seen in progress on the cooler box facing of the top half of the stator shell for a 200-MW. turbo-generator, at the Witton Works of the General Electric Co., Ltd. The half shell weighs 30 tons. Two turbo-generators of this capacity have been built by the Engineering Group for the South of Scotland Electricity Board, for installation in Kincardine B Power Station



shown at exhibitions held in different parts of the world.

LEECH (ROCHESTER), LTD., 277 High Street, Rochester, Kent, are mainly concerned with the design and production of precision optical lenses and scientific instruments. They supply the optical systems for the Enbeeco range of profile projectors, which are made by their associates, Newbold & Bulford, Ltd., also assemblies for microscopes and telescopes, and build special-purpose optical inspection equipment, to order.

Another product is the Jessop-Leech photo-elastic optical bench for carrying out tension and compression tests on a variety of models. The model is held upright in a frame which can be traversed vertically and horizontally in the optical field, and loads from 25 to 400 lb. can be applied by a screw-operated spring balance. White and monochromatic illumination can be obtained and provision is made for observation photography, screen projection, and microscopic examination of the model. Available with 4- and 6-in. diameter fields, these benches have been supplied to aircraft manufacturers, public authorities, and colleges.

Activities of the company also include the grinding of lead-glass blocks for nuclear reactors, in sizes up to 18 by 10 by 3 in.

F. W. HERRIDGE.

Computer Summer School

A Summer School with the theme Computers and Production Technology was organized recently by the Northampton College of Advanced Technology, St. John Street, London, E.C.1, and extended over five days, during which 14 papers were read by members of the College staff and by guest speakers from a number of companies with experience of operating computers. Two papers were specifically devoted to machine tools, namely "Computer Controlled Machine Tools", by Mr. B. J. Wood of Ferranti, Ltd., and "Computer Controlled Machine Tools—A User's Experience", by Mr. W. Ferris of the Dunlop Rubber Co., Ltd. Mr. Wood's paper dealt with a number of numerical control systems for machine tools, including that developed by his own company, and the part played by a computer in the work of planning and programming. He described the Ferranti control system, and measuring equipment, at its present stage of development, and forecast possible future developments, including fully-3-dimensional numerical control.

Mr. Ferris spoke of the experiences of his company over the past three years in operating an Archdale vertical milling machine which had been converted to numerical control under the Ferranti system. He quoted a large number of instances where significant savings in production costs and machining times had been effected, as compared with the conventional methods previously employed, and said that the machine was utilized continuously for 84 hours per week, on a 2-shift basis. It was employed mainly for small to medium batch production of aircraft parts, in quantities ranging from 20 to 200 pieces, and the operators were paid on a piece-work basis.

The main advantages which his company had gained, Mr. Ferris stated, were: reduced machining times; improved cutter life, as a result of the uniform feed rates at all stages of cutting; elimination of multiple set-ups, since many different operations could be included in one programme; complete interchangeability of components made from the same tape; and savings resulting from the elimination of complex jigs and fixtures, and their storage.

As a result of a study over a typical 12-week period, Mr. Ferris stated that the electronic equipment associated with the machine had proved to be between 90 and 100 per cent efficient, and over the same period production efficiency of the machine varied between 75 and 95 per cent—a strikingly high performance as compared with those of conventional machines.

Finally, Mr. Ferris made a plea to machine tool designers and builders for greater acceptance of numerical control techniques, and for a greater degree of co-operation with the manufacturers of the various systems. The conversion of standard machine tools to numerical control was a most unsatisfactory procedure, and he felt that greater use would be made of the technique if more machine tools which were specifically designed for numerical control were available.

Investigation of the Spark-hardening Process for Cutting Tools

(*Continued from page* 1391)

steel against the edge of the tool so that there is no gap, the surface of the "protector" being in the same plane as the surface of the tool to be treated.

It seems probable that as a result of the investigations to which reference has here been made it may be possible considerably to increase the practical effectiveness of the spark-hardening process. In this connection, however, it is evidently desirable that tests should be carried out with spark-hardened tools in the normal state and others treated in accordance with the authors' recommendations.

Birthday Honours

The recently published Birthday Honours list includes the following:—

Knights Bachelor

Allen, W. K. G., chairman and managing director, W. H. Allen, Sons & Co., Ltd., Bedford.

Baker, J. F., Professor of Mechanical Sciences and Head of the Department of Engineering, University of Cambridge.

Barratt, S., chairman, Albright & Wilson, Ltd.

Clark, A. G., chairman and managing director, Plessey Co., Ltd., Ilford, Essex.

G.B.E.

Stedeford, Sir Ivan Arthur Rice, chairman and managing director, Tube Investments, Ltd., and chairman, Advisory Group on the British Transport Commission.

C.B.E.

Barnard, C. F., executive vice-chairman, Mirrlees, Bickerton & Day, Ltd.

Lampitt, A. F., managing director, Telephone Cables, Ltd., Dagenham, Essex.

Page, F. W., director and chief executive, Aircraft Division, English Electric Aviation, Ltd.

Searby, N. H., manager, Guided Weapons Department, Ferranti, Ltd., Manchester.

Whipple, G. A., chairman and managing director, Hilger & Watts, Ltd.

O.B.E.

Bettenson, A. S., H.M. Superintendent Inspector of Factories, Ministry of Labour.

Bradshaw, C. S., Superintendent Engineer, War Office.

Brown, W. J., Director, Atomic Weapons Production, Ministry of Aviation.

Emery, C. S., lately sales director, Sir W. G. Armstrong Whitworth Aircraft, Ltd.

Melville, J., technical manager, Vickers-Armstrongs (Shipbuilders), Ltd.

Osborne, F. E., formerly chief test engineer, Rolls-Royce Spadeadam Rocket Establishment, now engineering manager, Rolls-Royce, Ltd., Lanarkshire.

Parry, E. W., director and engineering manager, Cammell Laird & Co. (Shipbuilders & Engineers), Ltd.

Sawney, L. T., chairman and managing director, Thermos, Ltd.

Personal

Mr. F. H. Ewens, F.C.A., has relinquished his joint managing directorship of W. Canning & Co., Ltd., Great Hampton Street, Birmingham, 18, but will continue to be chairman of the board. Mr. W. H. Griffin, J.P., is now sole managing director and deputy chairman. Mr. L. G. Mummery, F.C.A., has relinquished the office of secretary of the company and has become assistant managing director. Mr. E. L. Masek is now director responsible for London, Sheffield and Glasgow branches. Mr. B. Tromans, F.R.I.C., is now director responsible for the manufacture and control of chemicals, abrasives and polishing materials, and for the Technical Centre and Research Laboratories. Mr. D. Paddon-Smith, M.B.E., has succeeded Mr. S. Dawson (who retired on May 31), on the board. Mr. J. M. Stevens, A.C.I.S., is now secretary of the company.

The following new appointments have been announced:—

Mr. S. W. Perkins, a director of Wickman, Ltd., as a director of the Gisholt Machine Co. (Great Britain), Ltd., 161A Central Road, Worcester Park, Surrey.

Mr. Geoffrey Biddle, F.C.A., as general manager of Astley Leasing Co., a subsidiary of The Astley Industrial Trust, Ltd., Alport House, Quay Street, Manchester, 3.

Mr. R. F. G. Lea, deputy chairman and joint managing director of CIBA (A.R.L.), Ltd., Duxford, Cambridge, as a director of CIBA Clayton, Ltd., Manchester.

Mr. W. J. Austin-Clarke, Mr. J. Mayers, and Mr. O. Summers, as representatives in Staffordshire, Warwickshire, and Worcestershire, respectively, for Stubs Welding, Ltd., Scotland Road, Warrington, a subsidiary of Peter Stubs, Ltd. The company is marketing a new range of electrodes, including a type for the cold welding of cast iron.

Mr. P. K. Hart as assistant managing director of the three Northern units of the Kerry Manufacturing Group, namely, Qualters & Smith Bros., Ltd., Henry Broadbent, Ltd., and Oldfield & Schofield Co., Ltd., with headquarters at the Oldfield & Schofield works, Boothtown, Halifax; Mr. C. Goulding as factory manager of Qualters & Smith Bros., Ltd., Crookes Street, Barnsley; and Mr. J. Dunkerley as works director of Oldfield & Schofield Co., Ltd., in addition to being works director of Henry Broadbent, Ltd., Sowerby Bridge, Yorks.

New Plant for Amber Oils Ltd.

The arrangement whereby lubricants produced in Chicago, U.S.A., by D. A. Stuart Oil Co., Ltd., were distributed in the United Kingdom by Amber Oils, Ltd., has recently been altered, and in future the products of the former company will be made in Wolverhampton and sold here by D. A. Stuart Oil Co. (G.B.), Ltd., Lincoln Street, Wolverhampton, Staffs., a member company of the Amber Group, formed last year for this purpose.

New reaction vessels and associated equipment have already been provided in the Lincoln Street works of Amber Oils, Ltd., for the production of cutting oils and other lubricants to the Stuart formulae. Marketing arrangements provide for the sale of the full range of Stuart lubricants in this country and, if required, in Commonwealth markets where preferential tariffs are applicable. Col. D. G. N. Lloyd-Lowles, chairman of the Amber Group of companies, and Mr. J. G. Cronk and Mr. R. F. Middleton, both of Amber Oils, Ltd., visited the D. A. Stuart organization in the U.S.A. to study manufacturing and sales methods.

Correction

In the advertisement for Thos. C. Wild (Machinery), Ltd., Vulcan Works, Langsett Road, Sheffield, 6, which appears on page 145 of this issue of Machinery, the bed area of the 200-ton press is given incorrectly. It should be 8 ft. 4 in. by 4 ft. 2 in.

Industrial Notes

EX-CELL-O GROUP SALES, LTD., Hartford House, Charles Street, Leicester, are now handling the sales in this country of all products of Michigan Tool Co., U.S.A.

CRANE FRUEHAUF TRAILERS, LTD., is the title of a new company which has been formed by Cranes (Dereham), Ltd., South Green Works, Dereham, and Fruehauf International, Ltd., a subsidiary of Fruehauf Trailer Co., Detroit, U.S.A. This company will manufacture trailers at Cromer Road Works, North Walsham, Norfolk.

A NEW MOTOR VEHICLE WORKSHOP named after Mr. Frank Perkins, founder and chairman of F. Perkins, Ltd., has been officially opened at Peterborough Technical College. The shop is provided with machine tools and other equipment valued at about £4,000, presented to the College by the Perkins Group.

ZONE-REFINED TELLURIUM of high purity is now being produced by Johnson, Mathey & Co., Ltd., 73-83 Hatton Garden, London, E.C.1. It is stated that the total metallic impurity content, excluding selenium, is less than five parts per million, and is normally in the region of one part. The selenium content does not exceed five parts per million. The material is supplied as half-round bar, of approximately 1 in. by ½ in. cross section.

PEARSON PANKE, LTD., 1-3 Hale Grove Gardens, London, N.W.7, have been appointed agents for the United Kingdom for the Maypres range of cold forging presses and precision blanking presses; also for dieing presses and C-frame presses built by Georg Achtermann and sold under the name Acoma. These dieing presses incorporate a patented mechanism which is claimed to ensure exceptional accuracy of ram movement and ease of work removal.

SWALE CHEMICALS, LTD., 53 Park Hill Road, Croydon, Surrey, have introduced an easily strippable protective vinyl coating, designated type KP/100, for application to metal and glass. It can be applied by brushing, spraying, dipping, or flow coating. Intended primarily for the protection of polished surfaces, it can also be employed as an alternative to strippable tapes in painting and building construction.

THE BOROUGH POLYTECHNIC, Borough Road, London, S.E.1, have arranged a number of courses of special lectures for the winter term, 1961/62 session. The subjects of these courses are: Modern Developments in Non-destructive Testing of Metals; Refractories, their Manufacture, Properties and Uses; Recent Advances in Semi-conductor Metallurgy; and Corrosion and Protection of Buried Metal. Full particulars can be obtained on application to the Secretary of the Polytechnic at the above address.

THE TILLEY LAMP CO., LTD., Brent Works, Hendon, will shortly transfer their entire production facilities to a new factory on the Dunmurry industrial estate, near Belfast, Northern Ireland. The total area of the new works is 52,500 sq. ft., of which 35,000 sq. ft. is available for production purposes, and the factory is being leased from the Northern Ireland Ministry of Commerce. Provision has been made for future expansion of the production area if necessary.

RISE IN JAPANESE STEEL PRODUCTION.—In the first four months of this year, Japan displaced the United Kingdom as third largest producer of crude steel (apart from the U.S.S.R.). During the period Japanese output averaged 2,053,500 tons per month, as compared with 2,024,000 tons for the United Kingdom, 2,856,200 tons for Western Germany, and 5,875,600 (average for first three months) for U.S.A. It may be noted that the monthly average for steel production in Japan for the full year 1960 was 1,816,000 tons, for 1959 1,364,000 tons, and for 1958, 994,000 tons.

AIR CALL RADIOTELEPHONE EXPANSION.—The radiotelephone services operated by Air Call (Radiotelephone Division) of T.A.S., Ltd., 36 Wardour Street, London, W.1, have been augmented by the introduction of a second transmitting frequency. The system provides for a small transmitting/receiving set to be installed in a subscriber's car whereby messages can be sent and received, by way of intermediate stations, to and from the subscriber's business premises. A 24-hour service is maintained, and the system is operating at present within a 35-mile radius of London and Birmingham.

NEW PIGNON TOWER CRANES.—Seven new tower cranes, with maximum radii from 65 ft. 7 in. to 98 ft. 5 in. and lift capacity up to 2 and 3 tons, have been added recently to the French-built Pignon range, which is marketed in this country by George Cohen Sons & Co., Ltd., Wood Lane, London, W.12. These cranes are of an improved design, and it is claimed that the time required for erection has been reduced by approximately 50 per cent. In addition, considerable simplification has been permitted as regards the equipment necessary when a crane is arranged for "climbing" up a lift shaft, for example, during the progress of building work.

STATISTICAL QUALITY CONTROL AND ACCEPTANCE SAMPLING is the theme of a full-time 3-week course which is being organized by The College of Advanced Technology, Birmingham. Starting on September 11, the course is intended to provide both an introduction to the subject, and the basic training required for quality control engineers. The first two weeks will be devoted to the general principles and procedures of quality control, and the third week to lectures from specialists within industry and visits to various companies. Further details and application forms can be obtained from the Bursar, College of Advanced Technology, Gosta Green, Birmingham, 4.

THE INDUSTRIAL TRAINING COUNCIL, 36 Smith Square, Westminster, London, S.W.1, have now established nine regional committees in England, also similar committees in Scotland and Wales, with the object of keeping under review the recruitment and training of young people during the "bulge" years, that is, 1961 to 1964. The committees will also co-operate with the appropriate local

organizations in each of the regions. To date, the Council's work in this respect has been industrial rather than regional. It is anticipated that the new committees, whose function is advisory, will also serve as a link between local industrial organizations, when necessary, and in certain areas may be able to further the work of the Training Advisory Service of the Council.

PRESSURE DIE CASTING IN EUROPE.—The total production of pressure die castings in zinc and aluminium alloys in Western Europe, in 1960, was about 18 per cent above the 1959 level, according to data collected at the meeting of the European Pressure Die Casting Committee, held in Vienna on May 18, and made available by the Zinc Development Association, 34 Berkeley Square, London, W.1. The output of zinc-base die castings (in metric tons) for 1960 was as follows, the 1959 values being shown in parentheses:—Total, 136,000 (117,000); U.K., 65,000 (58,000); France, 22,000 (20,000); West Germany, 32,000 (25,000); and Italy, 9,000 (7,000). The corresponding values for aluminium-base castings were:—Total, 105,000 (87,000); U.K., 27,000 (23,000); France, 18,000 estimated (15,000); West Germany, 31,000 (24,000); and Italy, 21,000 (18,000).

U.S. Machine Tool Exports

The following table gives the quantities and value of exports of various classes of machine tools from U.S.A. in January, 1961:—

	Number	Value $
Light-duty and bench lathes	31	14,966
Engine lathes	52	238,681
Turret lathes	16	121,777
Automatic chucking and between-centre lathes	21	1,181,803
Automatic screw machines	113	2,326,562
Other lathes	20	217,822
Vertical boring and turning mills, and vertical turret lathes	8	153,889
Fine boring machines	5	136,768
Jig boring machines	6	170,584
Tapping and threading machines	146	228,912
Milling machines	22	139,046
Profiling, duplicating, and diesinking (milling type)	13	90,028
Gear-cutting machines	187	2,534,445
Gear grinding and finishing machines	25	471,919
Drilling machines	206	272,633
Planing, shaping and slotting machines	15	135,209
Surface grinding machines	63	727,713
Tool and cutter grinding machines	160	312,505
Other grinding machines	346	3,768,725
Sawing and cutting-off machines	42	246,971
Honing and lapping machines	30	128,824
Multi-station machine tools	4	622,996
Broaching machines	4	256,782
Hydraulic presses	62	702,429
Mechanical presses	89	783,517
Bending and roll forming machines	225	512,024
Punching and shearing machines	73	508,332
Forging machines and hammers	64	2,683,682
Other machines	115	711,397

Russian Orders for Coventry Gauge

Coventry Gauge & Tool Co., Ltd., Fletchhamstead Highway, Coventry, inform us that great interest was shown in their exhibits at the recent British Trade Fair in Moscow, and that as a direct result of their participation they have secured a further order from the U.S.S.R. for Matrix machines to the value of £250,000. The company states that the machines are scheduled for delivery in 1963, and include: two sizes of jig boring machines, one with optical and one with mechanical measuring equipment; a jig grinding machine; two long-thread grinding machines for operations on recirculating ball screws; an internal grinding machine for ball screw nuts; a universal thread grinding machine equipped for operations on hobs; and a special machine for grinding ball-steering worms for motor cars.

It may be recalled that the company already had orders in hand for Russia, secured during recent months, for machines and equipment to a total value exceeding £500,000.

B.S.A. Centenary

This year is the centenary of The Birmingham Small Arms Co., Ltd., Armoury Road, Birmingham, 11, and a special issue of the *BSA Group News* has been published to commemorate the occasion. No attempt has been made to present an official history and the story of the company's development and achievements, which is told largely pictorially, has necessarily been greatly abbreviated. An excellent impression is, however, conveyed of the part which the company, and the many subsidiary firms, have played in times of peace as well as in wars and of the great diversity of activities embraced. Sections are included, for example, under the titles: struggle for survival; in the morning of motoring history; trials of war and peace; from crucible to vacuum furnace; machine tools old and new; the other battle; going into training; and a Commonwealth of companies. Of particular interest are the references to the pattern of expansion of the Group since the last war.

New Companies Registered*

H. Palmer (Engineering), Ltd., 10 Hack Street, Deritend, Birmingham. Registered May 30, 1961. To carry on the business of manufacturers of and dealers in machine tools, press tools, etc. Nom. cap.: £1,000. Director: H. Palmer.

Otehall, Ltd., Otehall Works, Station Road, Burgess Hill, Sussex. Registered May 19, 1961. To take over the business of manufacturers of precision switches carried on at Burgess Hill as "Otehall & Co.," etc. Nom. cap.: £10,000. Directors: D. C. Beer (permanent), B. Beer, and R. A. Langridge.

Motley & Rogers (Toolmakers), Ltd., 6-8 Dettonford Road, Bartley Green, Birmingham, 32. Registered May 24, 1961. Nom. cap.: £1,000. Directors: F. W. Motley and E. Rogers.

L. De Vries & Son (Diamond Tools), Ltd., Unidex House, Cross Lane, London, N.8. Registered June 5, 1961. Nom. cap.: £100. Director: J. de Vries.

Winstanley (Die Sets), Ltd., Trading Estate, Pershore, Worcs. Registered June 5, 1961. To carry on the business of engineers, etc. Nom. cap.: £50,000. Directors: D. M. Kimberley, H. J. Kimberley, R. J. Kimberley, R. G. Medcraft and H. M. Winstanley.

W. Frost Engineers (Coleshill), Ltd., 2 Queens Road, Coventry. Registered May 31, 1961. Nom. cap.: £10,000 Directors: K. D. Wickenden and A. H. Smalley.

* From the lists compiled by Jordan & Sons, Ltd., Company Registration Agents, 116-118 Chancery Lane, London, W.C.2.

Churchill Acquire Henry Milnes

Charles Churchill & Co., Ltd., Coventry Road, South Yardley, Birmingham, have acquired the business of Henry Milnes, Ltd., Bradford, makers of boring machines, lathes, and other machine tools. It is stated that in accordance with the policy of the Churchill Group, the existing management of the company will continue in office.

Scrap Metals

†London.—‡Prices per ton for non-ferrous scrap metals free from iron are as follows:—Clean copper wire, untinned and free from lead and solder, £205; clean heavy copper, untinned and free from lead and solder, £200; copper wire No. 2, £196; clean light copper, £192; braziery copper, £168; gunmetal, £178; brass, mixed, £130; lead, net, £50; zinc, £40; cast aluminium, £93; old rolled aluminium, £96; battery lead, £25; unsweated brass radiators, £105; hollow pewter, £555; black pewter, £435.

Midlands.—The caution displayed in connection with copper about two weeks ago was apparently justified by subsequent market reports which indicated a considerable easing in prices. The same view still persists and there may be a further slight fall in values, particularly in view of the current level of production. Demand for scrap is good, and there are ample outlets for all grades.

In contrast, owing to the scarcity of tin there have been further gains, and the future position appears to be very strong. All tin bearing metals reflect this situation.

Copper.—Prices for most grades are lower by £4 to £6 per ton.

Brass.—There has been a fall of about £2 per ton in mixed brass with a similar reduction in rod swarf, bar ends, cuttings, and pressings.

Gunmetal.—Prices are firm with little change. Demand is good and an extra pound or two per ton can usually be obtained from buyers if justified by the quantities available.

Lead.—The situation is not impressive. Market prices show small variations in accordance with demand, which, in general, do not exceed about £1 per ton.

Aluminium.—Hopes of improved trading conditions, which at one time seemed imminent, have faded, and prices have eased. Old rolled material and swarf are not very popular with buyers, cast and new cuttings being favoured. The tone of the market is not very inspiring.

Zinc.—Prices have fallen by £2 to £3 per ton for most grades.

† George Cohen, Sons & Co., Ltd., 600 Wood Lane, London, W.12.
‡ Subject to market fluctuations.

Machine Tool Share Market

Stock markets were dull and unsettled with mainly quiet trading during the period under review. Prices drifted to lower levels in most sections, but encountered resistance.

The gilt-edged section was generally depressed, but after suffering slight setbacks gradually rallied to finish with fractional gains among British Government stocks and kindred issues.

Commercial and industrial markets were subdued and displayed an easier trend for the most part, but near the close the tone became steady to firm as a result of a mild revival of buying activity, and final prices were well above the lowest.

Among machine tool issues Asquith Machine Tool lost 6d. at 11s.; Birmingham Small Arms, 1s. at 26s.; British Oxygen, 3s. at 21s.; Chas. Churchill, 9d. at 8s. 9d.; Coventry Gauge & Tool, 1s. 3d. at 31s. 7½d.; Craven Bros. (Manchester), 1½d. at 10s.; A. A. Jones & Shipman, 1s. at 29s.; W. E. Norton (Holdings), 1s. at 9s.; Samuel Osborn, 2s. 6d. at 53s. 9d.; John Shaw & Sons (Wolverhampton), 3d. at 19s. 1½d.; Sheffield Twist Drill, 1s. at 18s. 6d.; Stedall & Co., 4½d. at 8s. 3d.; Tap & Die Corporation, 1s. 6d. at 16s. 9d.; and Thos. W. Ward, 9d. at 81s. 3d.

AMBROSE SHARDLOW & CO., LTD.—Final dividend 11 per cent, making a total distribution of 15 per cent for the year ended March 31.

WILLSON LATHES, LTD.—Final dividend 12½ per cent, making a total of 17½ per cent for year ended March 31.

Assessment of Surface Texture

The British Standard (1134:1961) concerned with the centre-line-average height method for the assessment of surface texture has recently been revised to take account of ISO developments and A.B.C. (American, Britain and Canada) agreements. In this connection it is pointed out that the techniques of measuring and controlling surface irregularities, as laid down in the specification, deserve to be more widely understood and used in industry. The principles whereby the irregularities of both machined and natural surfaces can be numerically assessed are clearly stated, and a comprehensive picture is given of measuring methods and problems.

Copies of the Standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. [Price 8s. 6d.—postage extra to non-subscribers.]

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	2/6
Allen (Edgar) & Co., Ltd.	Ord.	£1	43/6
” ”	5% Prf.	£1	13/6*
Arnott & Harrison, Ltd.	Ord.	4/-	17/-xd
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	11/-
” ” ”	6% Cum. Prf.	£1	16/6xd
Birmingham Small Arms Co., Ltd.	Ord.	10/-	26/-xd
” ” ”	5% Cum. “A” Prf.	£1	14/6
” ” ”	6% Cum. “B” Prf.	£1	17/-
” ” ”	4% 1st Mort. Deb.	Stk.	90½
British Oxygen Co., Ltd.	Ord.	5/-	21/-
” ” ”	6% Cum. Prf.	£1	20/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	10/1½xd
Broom & Wade, Ltd.	Ord.	5/-	24/9
” ”	6% Cum. Prf.	£1	16/6
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	16/-xd
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd.	Ord.	5/-	16/3
” ” ”	5% Cum. Prf.	£1	14/3xd
Churchill (Charles) & Co., Ltd.	Ord.	2/-	8/9xd
” ” ”	6% Cum. Prf.	£1	25/4½‡
Clarkson (Engrs.), Ltd.	Ord.	5/-	42/6
Cohen (George), 600 Group, Ltd.	Ord.	5/-	14/-
” ” ”	4½% Cum. Prf.	£1	12/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	31/7½
” ” ”	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	10/-
Elliott (B.) & Co., Ltd.	Ord.	1/-	4/6
” ”	4½% Red. Cum. Prf.	£1	12/-xd
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	11/-
Greenwood & Batley, Ltd.	Ord.	10/-	26/6
Harper (John) & Co., Ltd.	Ord.	5/-	8/6
” ” ”	4½% Red. Cum. Prf.	£1	11/9

COMPANY		Denom.	Middle Price
Herbert (Alfred), Ltd.	Ord.	£1	72/6
Holroyd (John) & Co., Ltd.	“A” Ord.	5/-	22/6xd
” ”	“B” Ord.	5/-	20/6xd
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	29/-
” ” ”	7% Cum. Prf.	5/-	4/9xd
Kearney & Trecker-C.V.A., Ltd.	5½% Red. Cum. Prf.	£1	11/-xd
” ” ”	Prefd. Ord.	£1	13/9xd
Kearns (H. W.) & Co., Ltd.	Ord.	5/-	25/-xd
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	10/7½
Macreadys Metal Co., Ltd.	Ord.	5/-	17/-
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/6
Massey (B. & S.), Ltd.	Ord.	5/-	12/-
Newall Engineering Co., Ltd.	Ord.	2/-	10/-xd
Newman Industries, Ltd.	Ord.	2/-	6/3
” ”	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd.	Ord.	2/-	6/-
Norton, W. E. (Holdings), Ltd.	Ord.	2/-	9/-xd
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	53/9
” ” ”	5½% Cum. Prf.	£1	23/-
Pratt (F.) & Co., Ltd.	Ord.	5/-	18/9
Sanderson Kayser, Ltd.	Ord.	10/-	38/9xd
” ”	6½% Cum. Prf.	£1	16/3xd
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	12/3
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	63/9xd
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	19/1½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	18/6xd
” ” ” ”	5% Cum. Prf.	£1	14/3
Stedall & Co., Ltd.	Ord.	5/-	8/3
Sykes (W. E.), Ltd.	“B” non-voting Ord.	10/-	31/3
Tap & Die Corporation, Ltd.	Ord.	5/-	16/9
” ” ”	4½% Deb. 1961-1977	Stk.	82½
Wadkin, Ltd.	Ord.	10/-	26/-
Ward (Thos. W.), Ltd.	Ord.	£1	81/3
” ”	5% Cum. 1st Pref.	£1	13/6xd
” ”	5% Cum. 2nd Pref.	£1	22/6xd
Willson Lathes, Ltd.	Ord.	1/-	3/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig Iron

Foundry and Forge No. 3, Class 2

Middlesbrough (10 tons or over)	£21 17 0
Birmingham (10 tons or over)	£21 9 3

Phos. Over 0·1 up to 0·4%

Birmingham (6 ton lots)	£23 5 0
Grangemouth (6 ton lots)	£23 10 0

Hæmatite

English No. 1 (10 tons or over)

N.E. Coast (made in N.E.)	£23 19 0
Scotland	£24 5 6
Sheffield	£25 9 0
Birmingham	£25 13 0

Welsh 10 tons or over	£23 19 0

Steel Products

Medium plates (50 tons and over)	£43 16 6
Mild steel plates, ordinary (50 tons and over)	£40 7 0
Boiler plates (50 tons and over)	£42 17 0
Flat bars, 5 in. wide and under (50 tons or over)	£39 1 0
Round bars, under 3 in. (50 tons or over)	£39 1 0
Billets, rolling quality, soft U.T. (100 tons or over)	£31 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d	£317 0 0

Copper

Cash (mean)	£234 17 6
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£313 10 0
Rods, 3/16 in. to ½ in. diam.	£330 0 0
Tubes, 1½ in. bore by 10 SWG, ton lots, per lb.	3s. 2½d.
Wire rod, black, hot-rolled (¼-5/16 in.), English	£250 7 6

Zinc

Refined, minimum 98 per cent purity, current month (mean)	£77 13 9

Brass

Tubes, solid drawn, basic per lb.	1s. 10⅜d.
Strip 63/37, 6in. by 10 SWG coils, ton lots	£264 0 0—£267 0 0
Rods, ¼-3 in. diam. (59 per cent copper)	2s. 1d.

Yellow Metal

Condenser plates, per ton	£192 0 0
Rods, per lb.	2s. 2d.

Aluminium

Ingots, min. 99·5 per cent Canadian d/d	£186 0 0

Tinplates

*U.K. Home trade: Cold reduced, f.o.r. makers works (15-50 tons)	£3 6 8
U.K. Export: Hot rolled basis, f.o.r. works port	73s. 6d.—76s. 0d.
Cold reduced basis, f.o.r. works port	73s. 6d.—76s. 0d.

Gunmetal

Ingots, B.S. 1400 L.G.2, delivered	£225 0 0

* Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f ex works, 2 tons basis	£42 17 0
Free cutting black	£47 6 6

Reeled Steel Bars[1]

Single-reeled, 1½ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 6
Free cutting	£47 19 0

Precision-ground Mild Steel[2]

1-in. diam. ± 0·00025-in. 4-ton lots, per cwt.	124s. 6d.

Bright Ground Stainless Steel Bars[3]

EN56AM (martensitic, free cutting)	£304 10 0
EN58AM (austenitic free cutting)	£377 10 0

Prices are basic, subject to extras.

High-speed Steel

Black random length bar. All prices basic, per lb., subject to extras:

Molybdenum "66"	6s. 5d.
Molybdenum "46"	6s. 3d.
14 per cent tungsten	6s. 11d.
16 per cent tungsten	7s. 4d.
18 per cent tungsten	7s. 9d.
22 per cent tungsten	9s. 2d.
5 per cent cobalt	10s. 10d.
4·75/5·25 molybdenum + 6·0/6·75 tungsten + 1·75/2·05 vanadium per cent (5-6-2)	6s. 7d.

Precision-ground, High-speed Free-turning Brass Rod[2]

⅝-in. diam. ±0·00025-in., 2 ton lots, per lb.	2s. 7½d.

Grey Iron Rod

Die Cast[4] in random lengths 18 in. to 26 in. rough machined 1/32-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
¾ or ⅞ in.	260s. 3d.	338s. 3d.
1 or 1⅛in.	208s. 4d.	267s. 3d.
1¼ to 1½ in.	146s. 3d.	181s. 7d.
1⅝ to 2 in.	112s. 7d.	133s. 6d.
2¼ to 3½ in.	97s. 1d.	112s. 9d.
3⅝ to 12 in.	91s. 9d.	105s. 3d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. diam. + 0·010 to 0·020 in., prices as quoted for die cast bar[4]

centreless ground	1 or 1⅛ in.	208s. 4d.
+0·010 in. Extra for hardenable	1¼ to 1½ in.	146s. 3d.
alloy iron[5]	1⅝in. to 2 in.	112s. 7d.
Per cwt. net	2¼ to 3½ in.	97s. 1d.

Stellite[6]

Welding Rods, plain

¼ in. diam., per lb.	30s. 0d.

Toolbits

¼ in. sq. × 4 in., each	22s. 3d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 2 Pratt, Levick & Co., Ltd., Chester. 3 Spartan Steel & Alloys, Ltd., St. Stephens Street, Birmingham, 6. 4 Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. 5 "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. 6 Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn:

(Usaspead) over 1 to 2 in.	£59 4 6
Lead bearing (Usaled)	£63 11 0
Precision ground, 1½ in.	£84 14 6

Bright Drawn

M.S. bars (M.M.C.) over 1½ to 2 in.	£56 10 0
Square edge flats (Usaflat)	£73 6 6
M.S. angles (Usaspead)	£100 6 6
Case hardening (EN) (Usacase over 1½ to 2 in.	£62 10 0
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£58 16 6
Carbon manganese semi-free cutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£71 5 0
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£67 3 0
0·4 carbon normalized (Usaspead "40") over 1½ to 2 in.	£69 5 0
0·45 carbon normalized EN9 (Usaspead 55)	£69 15 0
Carbon manganese steel to Specification EN16T (Usaspead 5565), per ton	£126 17 0

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspeed). List prices plus 10 per cent, less 5 per cent.

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.), ¼ in. to 2½ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.), ¼ in. to 2½ in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.)

Genuine Stubs quality, per lb.	4s. 10d. less 27½%
M.M.C. quality, per lb.	2s. 8d. + 6½%
Boxes of 16 assorted sizes, 1/16 in. to ⅝ in. diam.	7s. 6d.

Stainless Steel

KE40AM (free cutting), per lb.	3s. 8d

Glacier Machined Bronze Bars

Phosphor bronze (2B8), Lead bronze	Prices on application

High-speed Steel

18 per cent tungsten. Prices on application.

Toolholder bits:

Usaspead "Super", " "Supreme", " Cobalt 10	List price

Shimstock

Steel assorted, per tin	3s. 6d.
Brass " "	7s. 3d.

6 Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.

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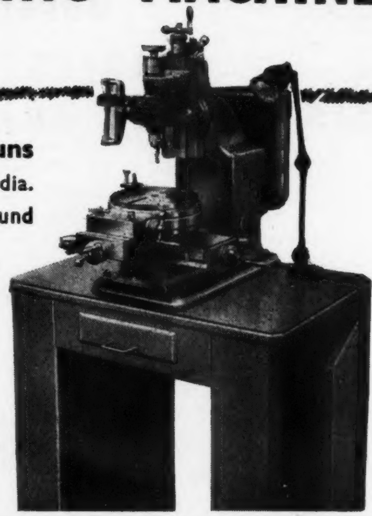

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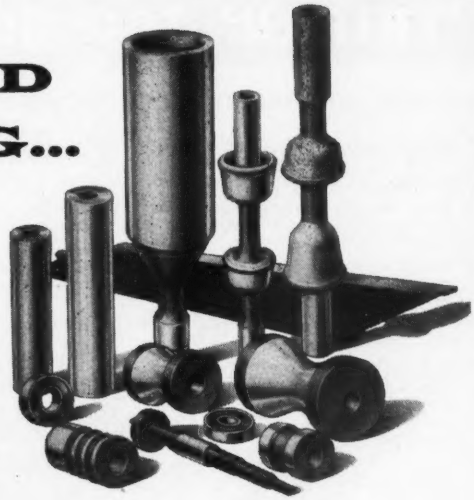
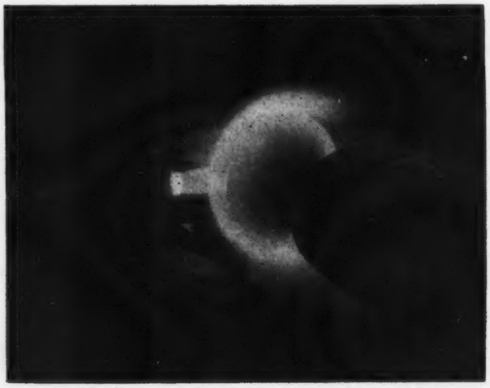


Spraying "Stellite" powder onto a parabolic valve.



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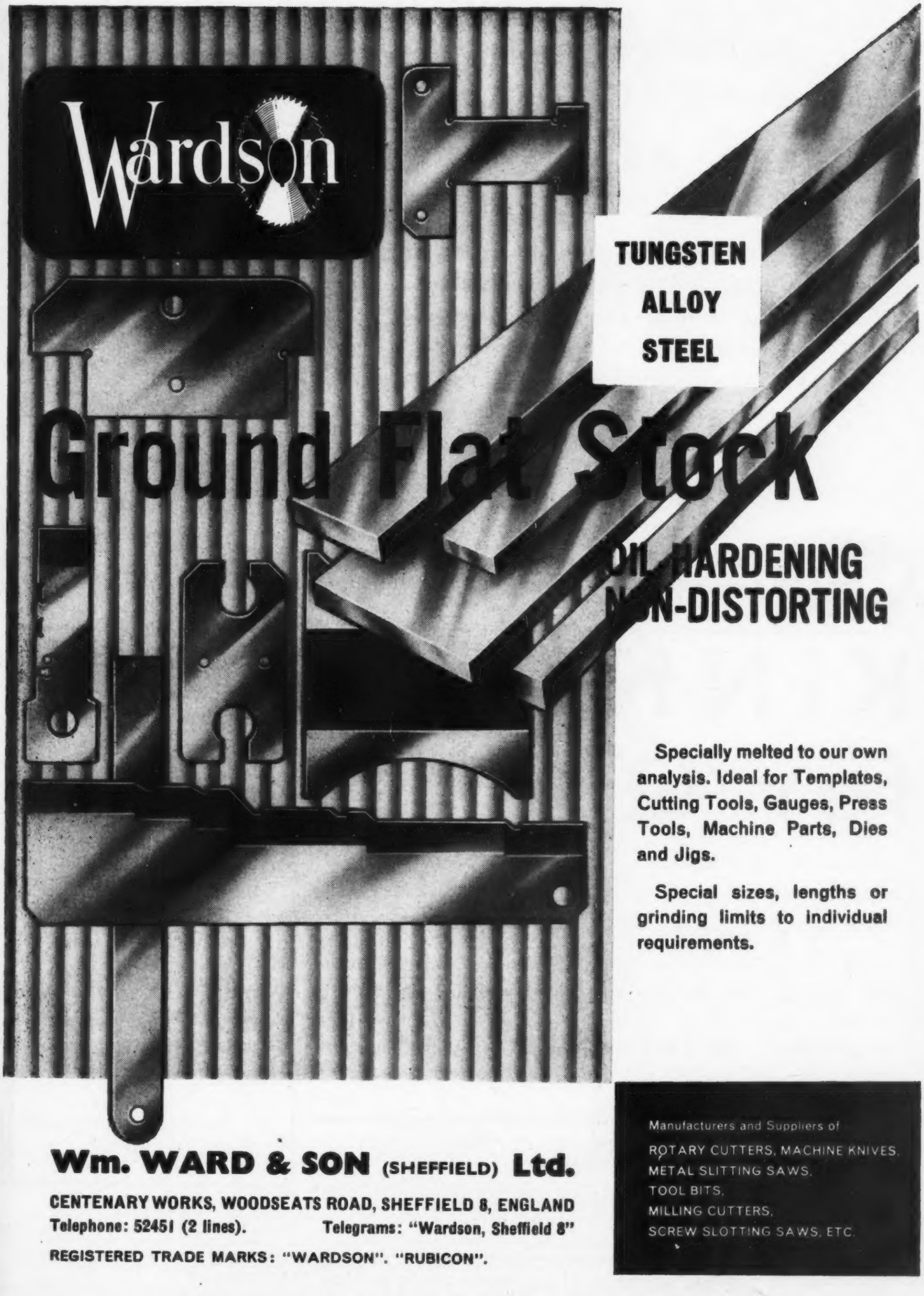
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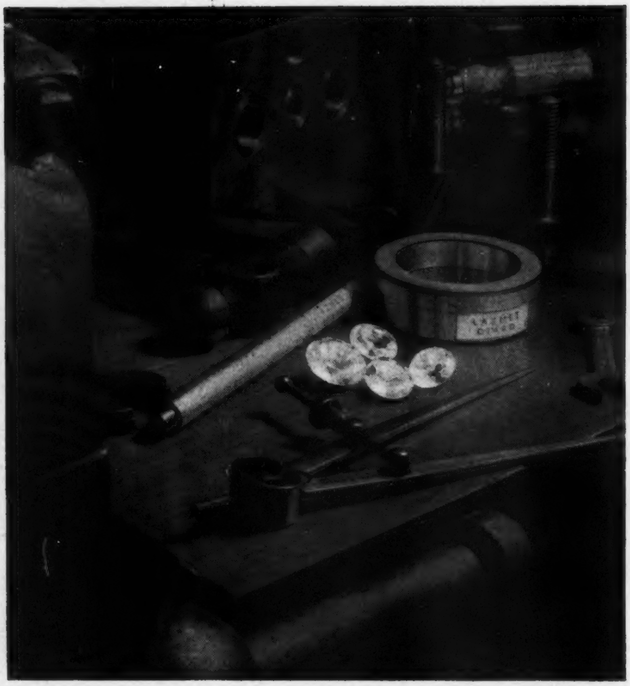

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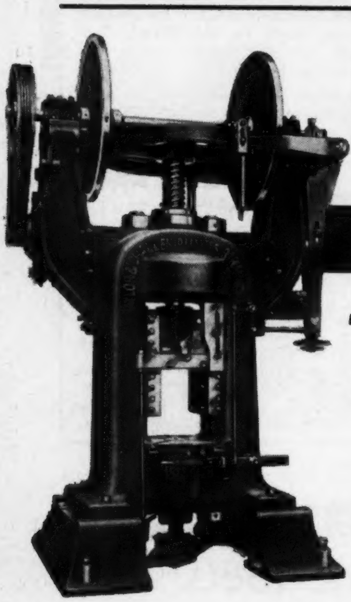

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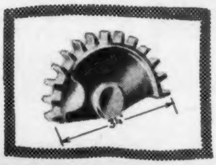

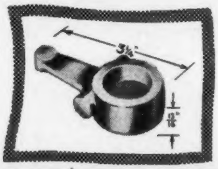

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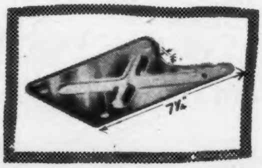

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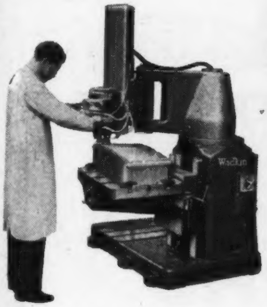
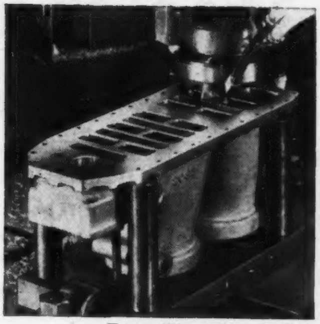
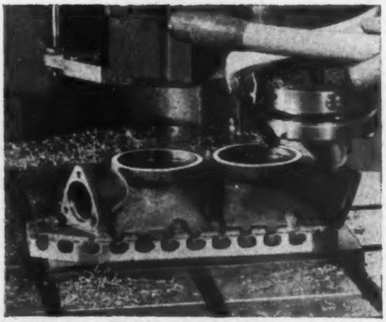


Wadkin Articulated Arm Router L.C.6





Face-milling Valve Body components on a Wadkin type L.C.6

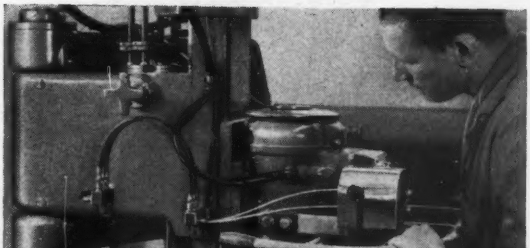
Wadkin Articulated Arm Router

cuts machining times by more than 50%

on light alloy components

D. Merrett & Co. Ltd., Tewkesbury are yet another firm who have taken advantage of the new Wadkin High-speed Milling Techniques.

Their Wadkin Articulated Arm Router, type L.C.6, recently installed to meet rising production costs, has cut machining times by more than one half! Type L.C.6 is a relatively inexpensive, medium capacity machine with cutting speeds up to 18,000 r.p.m. It has power rise and fall to the head, integral base plate, and rising and falling canting table. Details of the L.C.6 and the Heavy Duty Machine, type L.C. with either 6ft. 0in. or 8ft. 0in. reach are given in Leaflet 945. May we send you a copy?



Wadkin type L.C.6, face-milling a Valve Body Outlet, for Teddington Aircraft Controls Limited, at D. Merrett & Co. Ltd., of Tewkesbury.

This feature not previously associated with Routers enables table to be canted to the vertical on both left and right-hand side.

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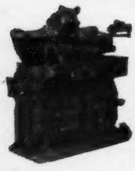

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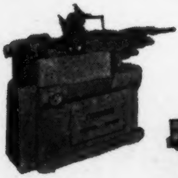

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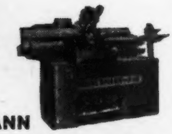

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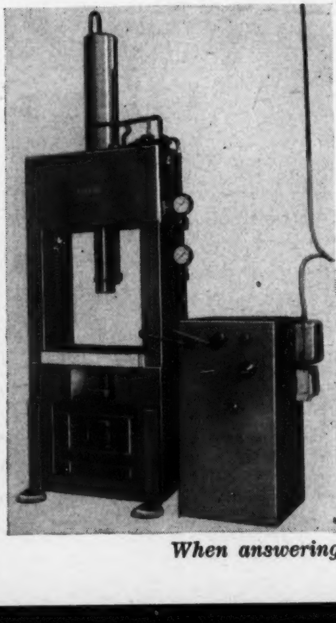

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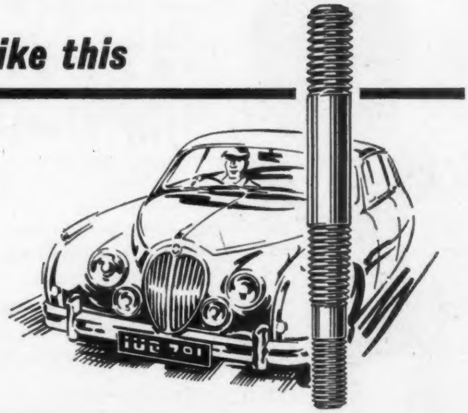

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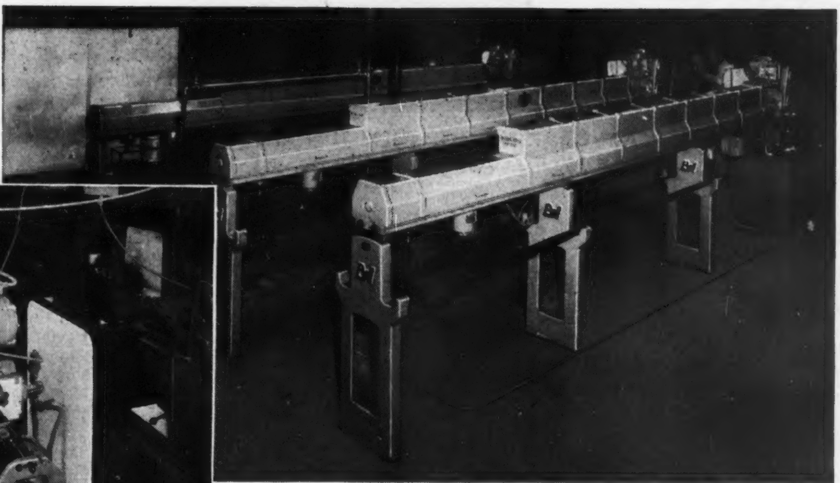

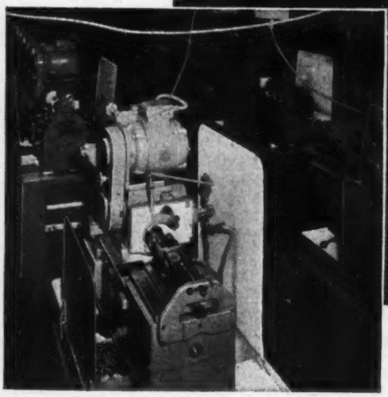

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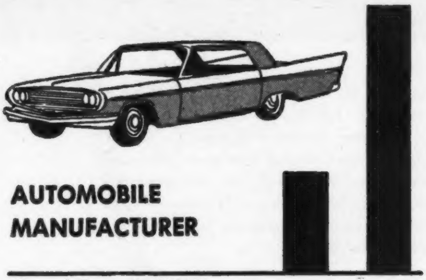
A Report from the General Electric Company, U. S. A.*

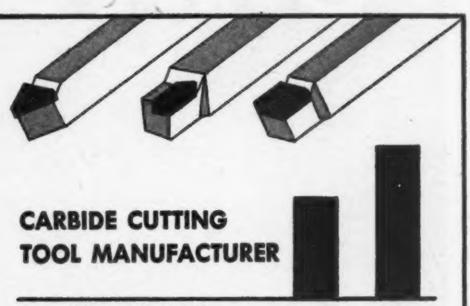
Here's Proof...General Electric Man-Made Diamonds Cut Grinding Costs...Increase Production



AUTOMOBILE MANUFACTURER

Natural diamonds: 100%
General Electric Man-Made diamonds: 262%

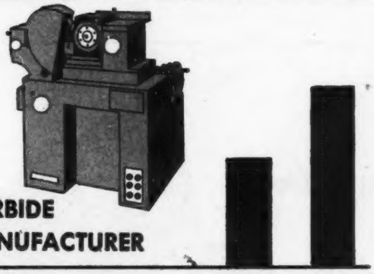
Tool and cutter grinding: 5"x 1¾"x 1¼" flaring cup wheels, resinoid bond, 100 concentration, 100 grit — dry grinding. Man-Made diamond wheel produced 1217 cutters and still had one-third of the wheel left. Natural diamond wheel produced only 696 cutters.



CARBIDE CUTTING TOOL MANUFACTURER

Natural diamonds: 100%
General Electric Man-Made diamonds: 144%

Single point carbide tool grinding: 6"x ¾"x 1¼" plain cup wheels, vitrified bond, 120 grit, 100 concentration—wet grinding. General Electric Man-Made diamond wheel removed 53.4 cubic inches of carbide compared to natural diamond wheel, which removed only 37.1 cubic inches.



CARBIDE MANUFACTURER

Natural diamonds: 100%
General Electric Man-Made diamonds: 163%

Cylindrical grinding: 16"x 2"x 12" straight wheels, vitrified bond, 120 grit, 100 concentration — wet grinding. General Electric Man-Made diamond wheel removed 1510 cubic inches of carbide; the natural diamond wheel removed only 928 cubic inches.

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In the electrolytic grinding of 311,000 carbide tools, 6 metal-bond wheels with General Electric's new MBG Man-Made diamonds were compared to 6 wheels containing natural diamonds. Here are the results:

Diamond Type	No. of Wheels	No. of Tools Ground	Avg. Wheel Wear Inches	Avg. Cu. In. Carbide Removed	Avg. Cu. In. Carbide Removed Per Cu. In. Wheel Wear	Efficiency Ratio
General Electric MBG	6	160,713	.0605	90.885	70.2	122.5
Natural	6	150,496	.0644	80.181	57.3	100.0

This comparison is only one example of the superiority of General Electric MBG Man-Made diamonds for metal-bond grinding wheels. This new, blocky, tougher crystal, in 80-mesh and finer, has also shown outstanding results in the grinding of sapphire, slicing and dicing of germanium and cutting coarse-grained alumina and carbides.

Get more information about General Electric Man-Made diamonds for either vitrified bond, resinoid bond or metal bond grinding wheels or saw blades. Contact: International General Electric Company of New York, Ltd., Lincoln House, 296-302 High Holborn, London, W.C. 1, England.

Or Write: International General Electric Company Dept. DI-61-1, 150 East 42nd Street, N. Y. 17, N. Y., U.S.A.

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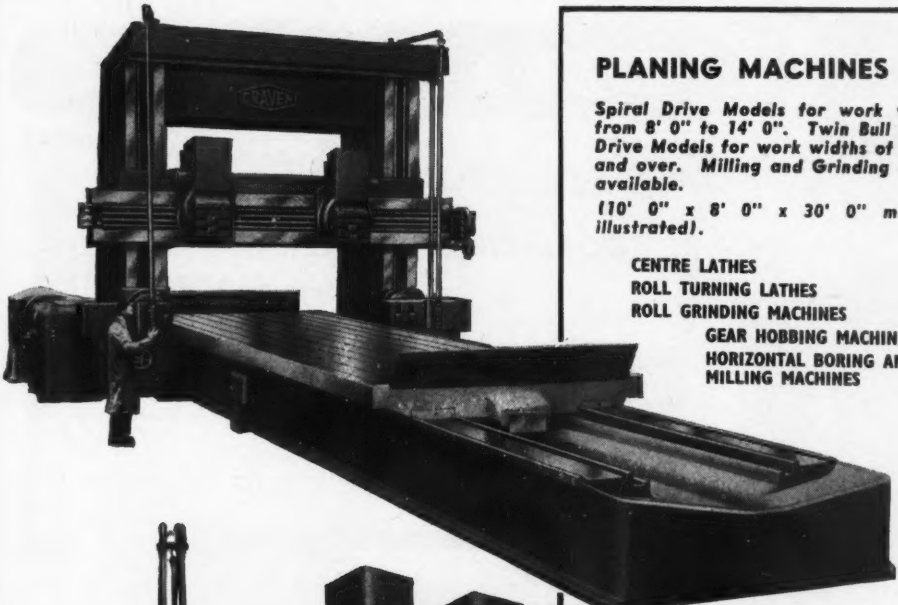

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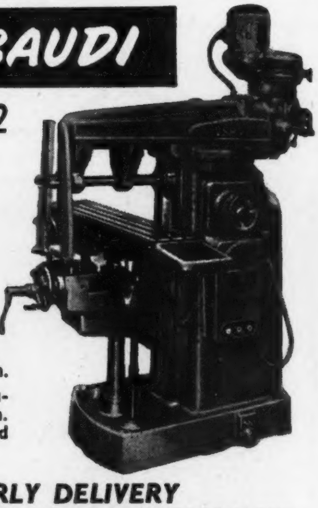

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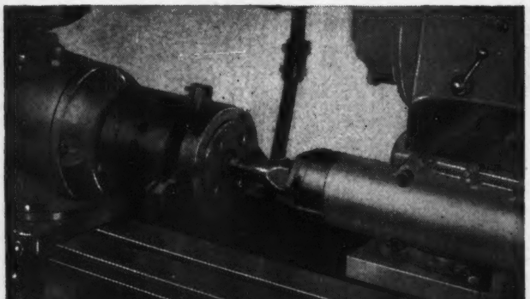

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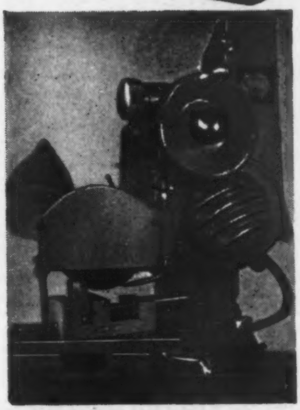

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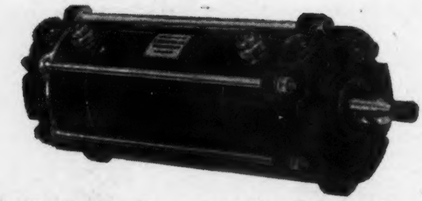

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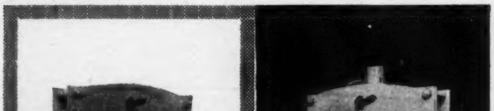

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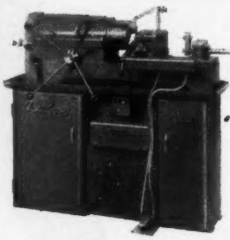

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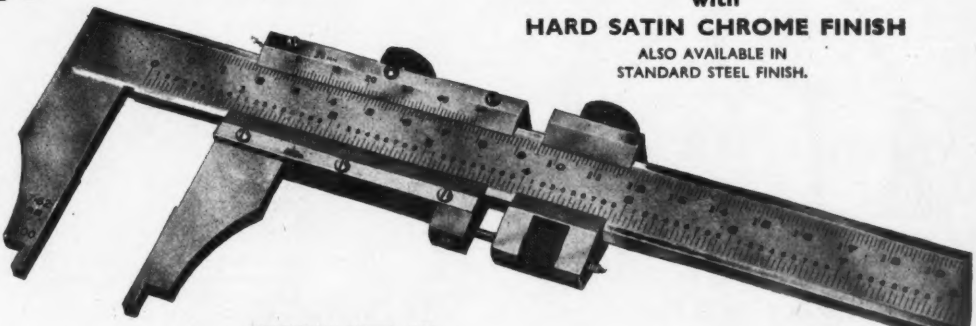

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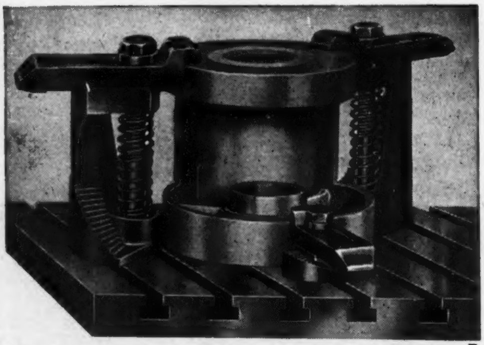

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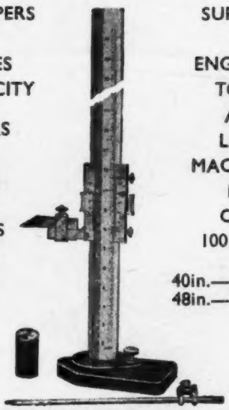

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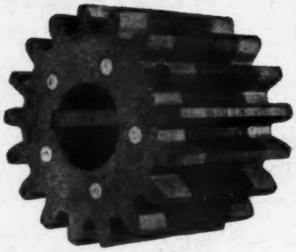

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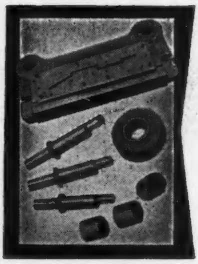

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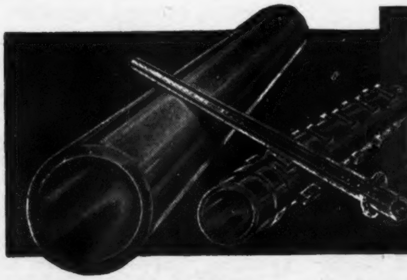

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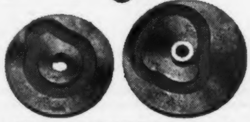

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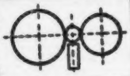

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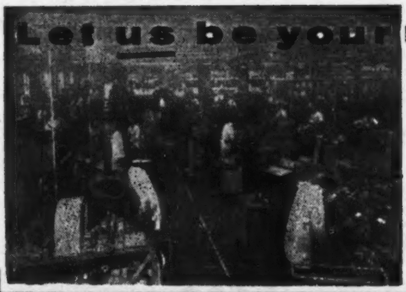

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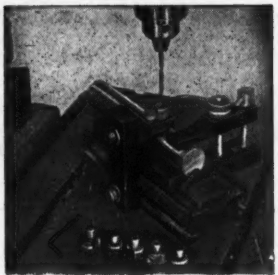

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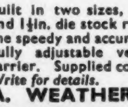

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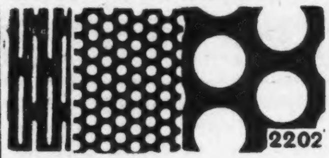

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MYFORD MG.12 Grinders.

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VICTORIA 02 Omnimils, U2 and U2R Milling Machines.

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BEAVER MILLERS.

ELLIOTT 7½in. Lathes.

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MITCHELL 8½in. and 12½in. Lathes.

COLCHESTER, CHIPMASTER, STUDENT & TRIUMPH LATHES.

SMART & BROWN 'A,' '1024' Lathes, Toggle Presses and Screwing Machines.

TOWN A.E.4 and A.E.5 3ft. 6in. and 4ft. 6in. Radial Drills.

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SIX—" RICHMOND " MODEL 01 UNIVERSAL MILLING MACHINES

Table 30¾in. by 8in. 16in. LONGITUDINAL TRAVERSE, EACH COMPLETE WITH VERTICAL ATTACHMENT, DIVIDING HEAD, ELECTRICS, and other useful equipment in metal tool cabinet.

ALL REBUILT. IMMEDIATE DELIVERY.

SIX—" MITCHELL " 8½in. CENTRES GAP BED S.S. and S.C. LATHES

54in. BETWEEN CENTRES. ALL IN VERY GOOD CONDITION AND EXCEPTIONALLY WELL EQUIPPED.

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HERBERT WIDDOWSON & SONS LIMITED

Canal Street Works, Nottingham · Telephone : 51891 (4 lines)

MEMBER OF B.A.M.T.M.

Classified Advertisements (PLANT FOR SALE, contd.)

M. WARD
(Machine Tools) Ltd.

1, KILBURN HIGH ROAD, LONDON, N.W.6
Tel.: Maida Vale 1195/6.
'Grams: Emwarneers, Kilb., London.

LATHES

COLCHESTER "Triumph," 7in. × 48in. Gap S.S. & S.C.
LE BLOND 15RP S. & S., 15in. × 24in.
CARDIFF S.S. & S.C. 8½in. × 48in. "Senior." 1952 M/c.
CRAVEN 36in. Swing × 12ft. Between S.S. & S.C.
SMART & BROWN 4in. × 18in. S.S. & S.C.
LANG 36in. Surfacing and Boring.
ACME No. 5W Capstan, chuck machine.
RYDERMATIC No. 12 Multi-Tool.
D.S.G. 13Z Minor S.S. & S.C.
WILLSON 6½in. × 36in. Gap Bed S.S. & S.C.

CAPSTANS AND AUTOS

WARD No. 7 Capstan, chucker.
HERBERT 4B D/L chuck and bar feed.
HERBERT 2S air-operated chucker.
TAYLOR No. 1263 Capstan, ½in. cap.

DRILLS

FOSDICK 4 BM. 3 spin. H/Sp.
CORONA 3M Pillar, 1¼in. cap.
KITCHEN & WADE 2ft. 6in. Radial, 2in. capacity.
CORONA Model 9FX Super High Speed Bench.
CORONA Model 12AX Bench, $\frac{5}{16}$in. cap.
BRISDON Model 52 Pillar, ⅝in. cap.

GRINDERS

KEIGHLEY KN Internal.
GRAND RAPIDS No. 35 Hyd. Hor. Spin. Surface.
HERBERT JUNIOR Surface, 10in. × 6in. × 9in.
BROWN & SHARPE No. 5 Surface.
BROWN & SHARPE No. 23 Plain, cap. 10in. × 48in.
BROWN & SHARPE No. 2 Surface, cap. 6in. × 18in.
SMART & BROWN Internal, 1½in. cap.
BROWN & SHARPE No. 5, 3in. × 18in. Plain.
BALLINGER 10/24 "Versatile" Abrasive Cutting-off Machine.
NEWALL Model L.U. 10in. × 36in. Hyd. Universal.
B.S.A. LANDIS Type C 6in. × 18in. Hyd. Plain.
SNOW Mod. O.S.72 Surface, cap. 15in. × 72in.
CHURCHILL Mod. H.C.B. Internal Auto Size.
HAHN & KOLB Hyd. Disc Lapping M/c.
JACKMAN No. 22 Disc, 18in. dia.
LUMSDEN Mod. 12M. Tool, 14in. × 2 wheel.

MILLERS—Vertical

REED PRENTICE Mod. 3VG, table 38in. × 10½in.
CINCINNATI Model O8 Production.
KENDALL & GENT Duplex Profile, table 18in. × 15in.

MILLERS—Horizontal

CINCINNATI Mod. O8 Plain Automatic.
BROWN & SHARPE No. 000 Plain Auto Miller.
BROWN & SHARPE No. 2 Universal, light type
RICHMOND 2HS Plain, table 35in. × 9in.
ARCHDALE 20in., table 40in. × 10in.
ASQUITH H.K.1 Duplex Keyway, table 43in. × 10in.
CINCINNATI Mod. O.K. Prod., table 34in. × 12in.
ARCHDALE 14in. Plain, table 27in. × 8in.
ARCHDALE 28in. Plain, table 49in. × 13in.

BORING MACHINE

KEARNS Mod. O.C. Horizontal, 3in. dia. spindle.

SAWING MACHINES

EHJ No. 13 Filing and Sawing.

SHAPERS

TOWN 14in.
HERBERT N.D. 20in.
ORMEROD 14in.

GEAR CUTTER

MAXICUT Gear Shaper, Mod. No. 2.

MISCELLANEOUS

T.T. & H. Javelin Etchers, Multi-heads (8 m/cs.).
HEAP 2in. Screwing Machine.

Newman

AUTOMATICS

BULLARD Multi-Au-Matic 7in. 8 spindle.
BULLARD Multi-Au-Matic 12in. 6 spindle.

BORING MACHINES

UNION Model BFT 100 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle (1955).
KEARNS No. 3 Horizontal Boring and Facing Machine, 3½in. diameter travelling spindle.
KEARNS No. 2 Horizontal Boring and Facing Machine, 3in. dia. travelling spindle.
KEARNS Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.
KEARNS No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.
WEBSTER & BENNETT Vertical Boring Machine, table 50in. diameter.
RICHARDS Type PRT Horizontal Floor Boring Machine, 3½in. travelling spindle, 28in. diameter facing head.
GIDDINGS & LEWIS No. 45 Horizontal Boring Machine, 5in. diameter travelling spindle.

CAPSTAN AND CENTRE LATHES

CHURCHILL-REDMAN Model 13NM Heavy-Duty S.S. & S.C. Gap Bed Centre Lathe, 15in. centre height × 72in. between centres. Swing in gap 50 in.
MITCHELL Model DM10 S.S. & S.C. Gap Bed Centre Lathe, 10½in. centre height × 7ft. 5in. between centres. (NEW).
OLDFIELD & SCHOFIELD Surfacing and Boring Lathe, 10½in. centre height.
WARD 7B Combination Turret Lathe.
NILES Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height × 28ft. between centres.
U.L.R.O. Heavy Duty Centre Lathe, 16in. centre height × 30ft. between centres.

DRILLING MACHINES

HETTNER Radial Drilling Machine, 10ft. elevating arm.

GEAR MACHINES

ORCUTT Model HM24 Hydraulic Internal Gear Grinder.
GLEASON 3in. Straight Bevel Gear Generator.

GRINDING MACHINES

CHURCHILL Plain Cylindrical Grinding Machine, 26in. swing × 84in. between centres (1951).
LANDIS Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing × 18in. between centres.
LANDIS Plain, Hydraulic Cylindrical Grinding Machine, 18in. swing × 72in. between centres.
ORCUTT Model HM24 Internal Spur Gear Grinding Machines.
CHURCHILL Plain Hydraulic Cylindrical Grinding Machine, 20in. swing × 72in between centres.
BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing × 36in. between centres.

MILLING MACHINES

CINCINNATI No. 3 High Speed Dial Type Vertical Milling Machine (1950).
CINCINNATI Model 5/72 Plain Hydromatic Milling Machine, table 91in. × 22in. (1952)
CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. × 10in.
CINCINNATI No. 1M Vertical Milling Machine.
CINCINNATI No. 4 Dial Type Horizontal Milling Machine.
GRAFFENSTADEN Model F1101 Plain Horizontal Milling Machine, table 52in. × 10in.
PRATT & WHITNEY Model BL3620 3-spindle "Keller" Die Sinking Machine.
CENTEC Model 3R Automatic Production Milling Machine, table 25in. × 16in.

MISCELLANEOUS

LANGE & GAILEN 28in. stroke Double Headed Hydraulic Shaping Machine.
TAYLOR & CHALLEN Double Sided 50-ton Geared Power Press, 10in. stroke.

NEWMAN INDUSTRIES LIMITED,

Machine Tool Division : YATE, BRISTOL

Tel.: Chipping Sodbury 3311. Telex. 44121. Cables: "Dynamo Yate."
London Office: Terminal House, Grosvenor Gardens, S.W.1. Tel: Sloane 8206. Telex. 23289.

Cashmores

Selection of Machine Tools from Stock

CENTRE LATHES

MITCHELL OF KEIGHLEY 8½in. S.S. & S.C. Lathe to admit 4ft. 3in. between centres.
MITCHELL OF KEIGHLEY 10½in. S.S. & S.C. Lathe to admit 4ft. 0in. between centres.
MITCHELL 7in. S.S. & S.C. All-Geared Head Gap Bed Lathe, to admit 3ft. 0in. between centres.
VOLMAN 8in. S.S. & S.C. Gap Bed Lathe, to admit 4ft. 6in. between centres.

BORING MACHINES

WEBSTER & BENNETT 36in. Vertical Boring Mill, table speeds 5.6/125 r.p.m.
WEBSTER & BENNETT 48in. Vertical Boring Mill, table speeds 4-88 r.p.m.

DRILLING MACHINE

New **KITCHEN-WALKER** 4ft. 6in. Radial Drilling Machine, No. 5 M.T. spindle.

GRINDING MACHINES

JONES & SHIPMAN Fig. 540 Horizontal Spindle Surface Grinding Machine, hydraulic feed 6in. × 18in. capacity.
One similar Machine with vertical spindle.
NORTON 6in. × 18in. Horizontal Spindle Surface Grinding Machine with hydraulic feed.
NORTON 6in. × 30in. Hydraulic Plain Cylindrical Grinding Machine, maximum wheel diameter 20in.

MILLING MACHINES

RICHMOND No. 4 Universal Milling Machine 50in. × 12in. table with vertical milling and slotting attachments.
EDGWICK No. 2 Dial Type Plain Horizontal Milling Machine 46in. × 11in. table.
ARCHDALE 20in. Dial Type Horizontal Milling Machine, 40in. × 12in. table.
GREENWOOD & BATLEY Plain Horizontal Milling Machine, working surface of table 20in. by 10in.
EDGWICK 18in. Horizontal Plain Production Milling Machine, with 40 in. × 12in. table.

PLANING MACHINE

SWIFT SUMMERSKILL 8ft. × 4ft. × 4ft. Planing Machine with 4 toolboxes, all electric Lancashire Drive.

POWER HAMMER

MASSEY 5 cwt. Pneumatic Side Type Power Hammer.
QUALTERS & SMITH 12in. capacity Heavy Duty Power Hacksaw.
SAGAR 30in. Woodcutting Bandsaw with canting table.

SLOTTING MACHINES

BUTLER 14in. stroke All Geared Slotting Machine with 39in. diameter rotary table.
DUTRANNOIT 24in. stroke Precision Slotting Machine with swivelling head, 39½in. table

SHAPING MACHINES

New **ALBA** 24in. and 18in. stroke Shaping Machines.
BUTLER 18in. Heavy Duty Shaping Machine.

SHEARING MACHINE

New **KEETONA** 8ft. 0in. × ¼in. Undercrank Guillotine Shearing Machine.

STRAIGHTENING ROLLS

BRONX 8ft. 0in. × ¼in. Straightening Rolls 5 roll type.
All the above machines are motorised 400-440/3/50 cycles.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

Harry Kirk Eng Ltd

can recommend the following modern quality machines from STOCK

AUTOMATIC

RYDER Verticalauto, capacity 16in. swing × 8in., 6 spindles.

BORING MACHINES

RICHARDS 36in. Vertical Boring Mill, complete with side head.

JONES 6in. Spindle Horizontal Borer. Table 17ft. 6in. × 8ft. Spindle travel 48in. Rapid traverse 84in. per min. Motorised 400/3/50. Weight 70 tons.

BULLARD 36in. Vertical Boring Mill.

KITCHEN & WADE Vertical Fine Boring Machine. 14in. stroke. Compound table.

DRILLING MACHINE

ARCHDALE 8-Spindle Hydraulic Vertical Drilling Machine.

GRINDING MACHINES

HEALD No. 172 Gap Bed Internal Grinding Machine, maximum diameter of component 36in.

LATHES

NOBLE & LUND Heavy Duty Centre Lathe, 22in. centre height × 29ft. between centres Max. swing over saddle 33in. dia.

HARVEY Heavy Duty Centre Lathe, 42½in. centre height × 52ft. between centres. Max. swing over saddles 65in. dia.

MILLING MACHINE

COLLET & ENGLEHARDT Keller Type Die Sinking Machine. Model FKf80, capacity 60in. × 30in.

PLANING MACHINES

CLEVELAND Openside Planing Machine capacity 10ft. × 2ft. 6in.

CINCINNATI Planing Machine, capacity 8ft. × 2ft. 6in.

MISCELLANEOUS MACHINES

CLIFTON & BAIRD Horizontal Cold Sawing Machine, 30in. dia. Saw. Maximum capacity 22in. × 7in R.S.J.

Hydraulic Vertical Internal Honing Machine (manufactured by **PETER WOLTERS**), Capacity 0.2in. to 2in.

RAPIDAN Double Helical Gear Generating Machine, 12in. diameter capacity.

Further details from

HARRY KIRK ENGINEERING LTD.,

BRANDON ROAD WORKS, BRANDON ROAD, COVENTRY.

'Phone:
WALSGRAVE-ON-SOWE 2253 (6 lines).

ACBARS LIMITED,

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Telephone: RODney 7822.
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AVAILABLE FROM STOCK

All machines listed below are at our Works in Sutherland Walk, Walworth Road, S.E.17

AUTOMATICS

HERBERT Auto Juniors (2).
RYDERMATIC No. 12 Vertical Multi-Tool Lathe.

BROACH

FORST RIAS Universal Vertical Broach for internal and surface broaching, 5 tons, 39⅜in. stroke. 1952 machine.

RADIAL DRILL

New VOEST Swivel Head Radial, 1in. capacity, 3ft. 3in. radius.

GRINDERS

BROWN & SHARPE No. 2 Surface.
JUNG AS Internal.
CHURCHILL HBY Internal.
KEIGHLEY Type XL Hydraulic Plain Grinder, 6in. × 18in.
CHURCHILL 10in. × 24in. Universal.
LANDIS 12 × 48 Universal.
BROWN & SHARPE No. 3 Universal.
NORTON 14in. × 36in. Universal.
New BAMKIN Tool and Cutter.

CAPSTAN AND TURRET LATHES

LIECHTI PR Turret Lathe (Swiss).
GISHOLT IL Turret Lathes.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES

SMART & BROWN Type M 4in. Precision.
WARD, HAGGAS & SMITH 8½in. Gap Bed, 36in. between centres.
CROMWELL 3½in. Precision.

MILLERS

ARCHDALE 14in. Manufacturing type.
CINCINNATI Type OK 18in. Horiz.
EDGWICK 18in. Horizontal.
ARCHDALE 20in. Twin Overarm Horizontal. Table 40in. × 10in.
KENT-OWENS 1-8 and 1-14 Hydraulic Production.
MILNES Sw. Hd. Vertical. Table 30in. × 8½in.
HERBERT 23V Vert. Table 68in. × 17in. 48in. traverse.
REED PRENTICE No. 6 Vertical. Table 84in. × 20in.
HOLROYD T117 Thread Miller.
HELLER Automatic Thread Millers (4).
ASQUITH HKO Duplex Keyseater.

PRESS

V & O. No. 11 Double Action. Approx. 10 tons. Roll feed. Max. draw 1in.

All machines motorised 400/3/50 unless otherwise stated.

Butters Bros. Derrick Crane 3 tons capacity, 90ft. 0in. jib, cabin type. All electric and in excellent condition.
Further details from —
C. & G. OLDFIELD, LTD.,
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Rhodes 40 Ton Power Press, 400/3/50.—A. McNAMARA & CO. LTD., New Line, Bacup, Lancs. Tel. Bacup 946.

GATE

MACHINERY CO., LTD.

176/178, Victoria Road, Acton, LONDON, W.3. ACOrn 8881

GRINDERS

JONES & SHIPMAN 540 Surface Grinder.
ROBOT 6in. × 18in. Surface Grinder.
NEWMAN 10in. × 24in. Universal Grinder.
BROWN & SHARPE No. 2 Surface Grinder.
HORTSMAN Thread Grinder, capacity 5in. dia. × 9in. b.c.
BROWN & SHARPE No. 5 Cylindrical Grinder.
FRITZ WERNER Model 270A Cylindrical Grinders, 3½in. × 7in. b.c.
BROWN & SHARPE No. 13 Universal Grinder.
BRYANT No. 5 Heavy Duty Internal Grinder.
BENTLEY Form Cutter Grinder.

LATHES, CAPSTANS

D.S.G. 8½in. × 48in. Gap Bed, 19-418 r.p.m.
D.S.G. 8½in. × 30in., 11-490 r.p.m.
HOLBROOK 8in. × 36in., 11-400 r.p.m.
COLCHESTER MASTER 6½in. × 36in. Ainjest Screwing Attachment.
LE BLOND "Regal" 7in. × 40in., 25-500 r.p.m.
EMPIRE 6½in. × 40in. Lathe.
SOUTHBEND 5in. × 24in. Bench Lathe.
BOYES & EMMS S.S. & S.C. Lathe, centre height 16in. × 7ft. 6in.
ROLLO 6½in. Centre Lathe.
HENDY 13in. × 30in. S.C. Lathe.
RIVET 4in. × 18in. b.c. Precision Lathe.
WARNER & SWASEY No. 3 Capstan.

MILLERS

CINCINNATI 8in. × 18in. Tool and Die Miller.
EDGWICK No. 2 Universal, 46in. × 11in. table, 24-405 r.p.m. Vertical Attachment Dividing Head.
TRIDENT Vertical, table 30in. × 8in., 75-750 r.p.m.
CINCINNATI 1-18 Production Miller.
KENDALL & GENT Vertical Miller, table 69in. × 19in., speeds 20-300, rapid traverses.
SCHIESS DEFRIES Vertical Keyseater.
MAMMUT 10in. × 23in. Table Horizontal Mill, hand lever operated.
FRITZ WERNER 10in. × 34in. Horizontal Mill.
BROWN & SHARPE No. 2 11in. × 49in. Horizontal Mill, speeds 15-376. Feeds 3/10-15 I.P.M.

PRESSES, SHAPERS, PLANERS AND HOBBERS

BUTLER 14in. Production Slotter.
INVICTA 5m. Shaper.
ORMEROD 8in. Toolroom Slotter.
CHURCHILL-REDMAN 32in. Stroke Heavy Duty Shaper. Excellent condition.
ESSEX No. 32 Punch Shaper.
30-ton **RASKIN** Double Sided Double Geared Drawing Press. Area 20in. × 23in. Draw 4½in.
New **POREBA** Model HDA.80 Planer, capacity 10ft. × 32in. × 30in. table, drive by Heid gearbox.
DOWDING V8 Gear Hobber.

DRILLS

POLLARD 4-spindle Pedestal Drill, 2-2MT 2-3MT.
POLLARD 3-spindle Pedestal Drill, 3MT, 110-1,455 r.p.m. Power Feed.
POLLARD 13 AX Pedestal Drill.
PROGRESS 4E Pillar Drill.
TAUCO ½in. Bench Drill.
BOLEY Multi Drill VB 10in.
CORONA 13in. 2AP Sensitive Pedestal Drill.
CORONA 20in. Pedestal Drill.
15HEF 4 Spindle Drill.

MISCELLANEOUS

CANNING Double Ended and Centreless Polishing Machines.

Classified Advertisements (*PLANT FOR SALE, contd.*)

SELECTED MACHINES

MATHEYS Jig Boring Machine. Type SP/30. No. 290. Speeds 145-2,000 r.p.m. Table 30in. × 9½in. 230/1/50.

JONES & SHIPMAN No. 540 Surface Grinder. Capacity 18in. by 6in., hydraulic table feeds. Magnetic chuck, electric coolant.

SOMUA Horizontal Milling Machine, table 67in. × 14¼in., spindle speeds 32 to 1,250 r.p.m. No. 50 I.T. 18 feeds 1/16in. to 10 1/16in. per min., power feeds and rapid traverse in all directions. 1952 machine.

VICTORIA P2 Horizontal Mill, table 45in. × 11in., 1959 machine in new condition.

HULLER UG5 Tapping Machine, capacity up to 1¼in., pedestal machine with coolant, controlled pitch. Reconditioned.

HERBERT No. 2 Flash Tapping Machines, pedestal Machines, with coolant, controlled pitch. Late type Machines.

All machines motorised 415/3/50.

A. LAWRENCE & CO., (MACHINE TOOLS) LTD.,
WELSH HARP, EDGWARE ROAD, LONDON, N.W.2.
Tel.: GLA. 0033.

12½in. Centre Swift Heavy-Duty m/d. all-gd. hollow-spindle S.S. & S.C. Lathe with two saddles each with taper turning attachments. 20 h.p. 400/3/50 motor, 18 spindle speeds 1.5-94 r.p.m. Spindle mounted in Timken roller bearings.—LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone 84246.

Cincinnati No. 2 M.H. Plain Horizontal Milling Machine, W.S.O.T.. 7in. × 44in.

Further details from —
C. & G. OLDFIELD, LTD.,
15, Abercorn Street,
PAISLEY.

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DALSTON JUNCTION,
LONDON, E.8
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Tel.: CLIssold 0513/4

BALLINGER Abrasive Cutting off Machine, 16in. wheel, 400/3/50. £250.

36in. **TANNEWITZ** Bandsaw, Tilting Table, 400/3/50. £162.

EDWARDS Nibbler, 30in. Throat, 400/3/50. £50.

EDWARDS 48in. × 14 Gauge Power Guillotine. 400/3/50. £250.

EDWARDS 42in. Treadle Guillotine, 18 Gauge £47 10s.

SOUTHBEND 4½in. Bench Lathe, 24in. Between Centres, 3 Jaw Chuck, Changewheels, etc., motorised 230/1/50. £45.

BANTAM 5in. Lathe, 400/3/50 with 3 and 4 Jaw Chucks. £65.

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Oliver No. 16 Lock Former For Sale. For high speed edge forming in sheet metal up to 16 s.w.g. Operating speed 20ft. per min. Complete with forming rollers, Motorised 440/3/50.—F. J. EDWARDS LIMITED. 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

B.S.A. No. 48 Single Spindle Auto, New and under Maker's Guarantee. —BOX D43, MACHINERY, Clifton House, Euston Road, N.W.1.

Cunliffe & Croom Broaching Machine, 40in. stroke, 400/3/50. £185.—A. McNAMARA & CO. LTD., New Line, Bacup, Lancs. Phone: Bacup 946.

MIDLAND

BORING MACHINES

WEBSTER & BENNETT 4ft D Type Vertical Borer. Speeds 5 to 109 r.p.m.

BENDING ROLLS

RHODES 8ft. × 14 gauge Power Bending Rolls.

CROPPING MACHINES

Double Ended Angle Cropping Machine. Cap. up to 6in. × ⅝in. angles.

DRILLING MACHINES

POLLARD 13in. Pillar Drill No. 2 Morse Taper. R. & F. Table 11in. × 11in.

ARCHDALE 28in. H/Duty Pillar Drill No. 4 Morse Taper. R. & F. Table Elc. Suds.

FOLDING MACHINES

EDWARDS 6ft.×⅛in. Swing Beam Universal Folder.

GRINDING MACHINES

New **NORTON** 10in., 12in., 14in., 16in., and 20in. D/E Tool Grinders.

ABRASIVE No. 34 24in. × 8in. Vertical Spindle Surface Grinder.

GUILLOTINES

EDWARDS 4ft. × ⅛in. O/Crank Guillotine.

HAMMERS

MASSEY 5 cwt. Slide Type Pneumatic Hammer. 400/3/50.

MILLING MACHINES

VAN NORMAN No. 26 Horizontal and Vertical Milling Machine. Slotting Head.

MILWAUKEE 3.H Vertical Milling Machine.

PRESSES

TAYLOR & CHALLEN "370" 20 Ton O/F Press.

TAYLOR & CHALLEN "845" Dial Feed Notching Press.

BRADLEY & TURTON No. 3 Flypress.

SWEENEY & BLOCKSIDGE Bench Press. Cap. 3 tons.

SCREWING MACHINES

KENDALL & GENT 3in. Screwing Machine. Leadscrew Type.

POLISHING MACHINES

3 and 5 H.P. Double Ended Polishing Spindles.

All machines 400/3/50 electrics unless otherwise stated.

THE MIDLAND MACHINE TOOL CO.
BRADLEY, BILSTON, STAFFS.
Tel.: Bilston 42471/9.

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FINE MACHINE TOOLS *at*

B. ELLIOTT (MACHINERY) LTD
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Landis 10in. × 24in. Type "C" Universal Grinder. Internal Attachment. New condition.

Further details from:—
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Rotos Vertical spindle surface Grinder table 33in. × 7½in. £125; Colchester 8½in. Lathe with Sadi drive £85; Alba 18in. shaper £105; Rex 6in. Powersaw £65; German 7in. Lathe with powerlastic drive £55; Warner & Swasey 1in. Capstan £75; 37in. treadle Guillotine £35.—BOX D45, MACHINERY, Clifton House, Euston Road, N.W.1.

Taylor & Challen B3½in. Power Press. 60 Ton capacity. 3in. stroke. Fitted 9in. double roll feed. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

AUTOS

CONOMATIC 1¼in. 8 spindle. Type W.W.
WICKMAN 1⅝in. 5 spindle. 1941 machine.
WICKMAN 1⅝in. 5 spindle. 1941 machine.
WICKMAN 6in. 5 spindle Chucker.

DRILLING

ASQUITH 4ft. 6in. O.D.1 Radial Drill.
ASQUITH 4ft. O.D.1 Radial Drill.
PROGRESS 5E. Round table.

GEAR SHAPING

Model 61 **FELLOWS** Gear Shaper. Straight spur, 35in. dia. × 5in. face width.

LATHES

WARNER & SWASEY No. 2A Long Bed.
SOUTHBEND 16in.
EDGWICK 7in.
DEAN, SMITH & GRACE. Height of centres 7in.
MONARCH 22M S.S. Taper Turning Lathe.
WARD 10 Combination Turret Lathe.

MILLING

20in. **ARCHDALE** Plain Mill Rapid.
28in. **ARCHDALE** Rapid All Ways.
18in. **EDGWICK** Production Mill.
CINCINNATI No. 5 High Pow Plain Hor. 1942 machine.
KENDALL & GENT C.V.M.40
KENDALL & GENT C.V.M.25 Vertical Mill.

SHAPING
GUILLOTINES

EDWARDS 6ft. × 3/16in. Overcrank.
EDWARDS 8ft. × ⅛in. Overcrank.

FOLDERS

MORGAN 6ft. × 14g. Universal.
EDWARDS 6ft. × ⅛in. Swing beam, hand geared.
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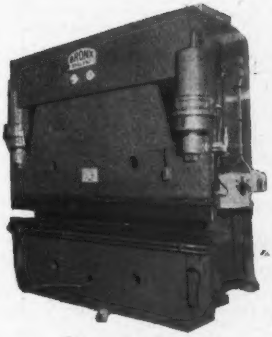

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4A **LIBBY** Turret Lathe.
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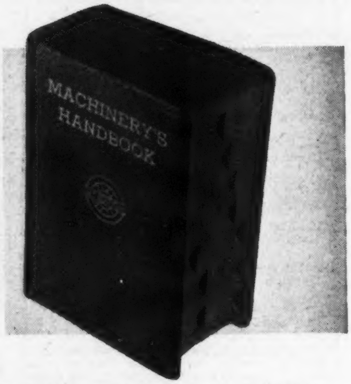

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